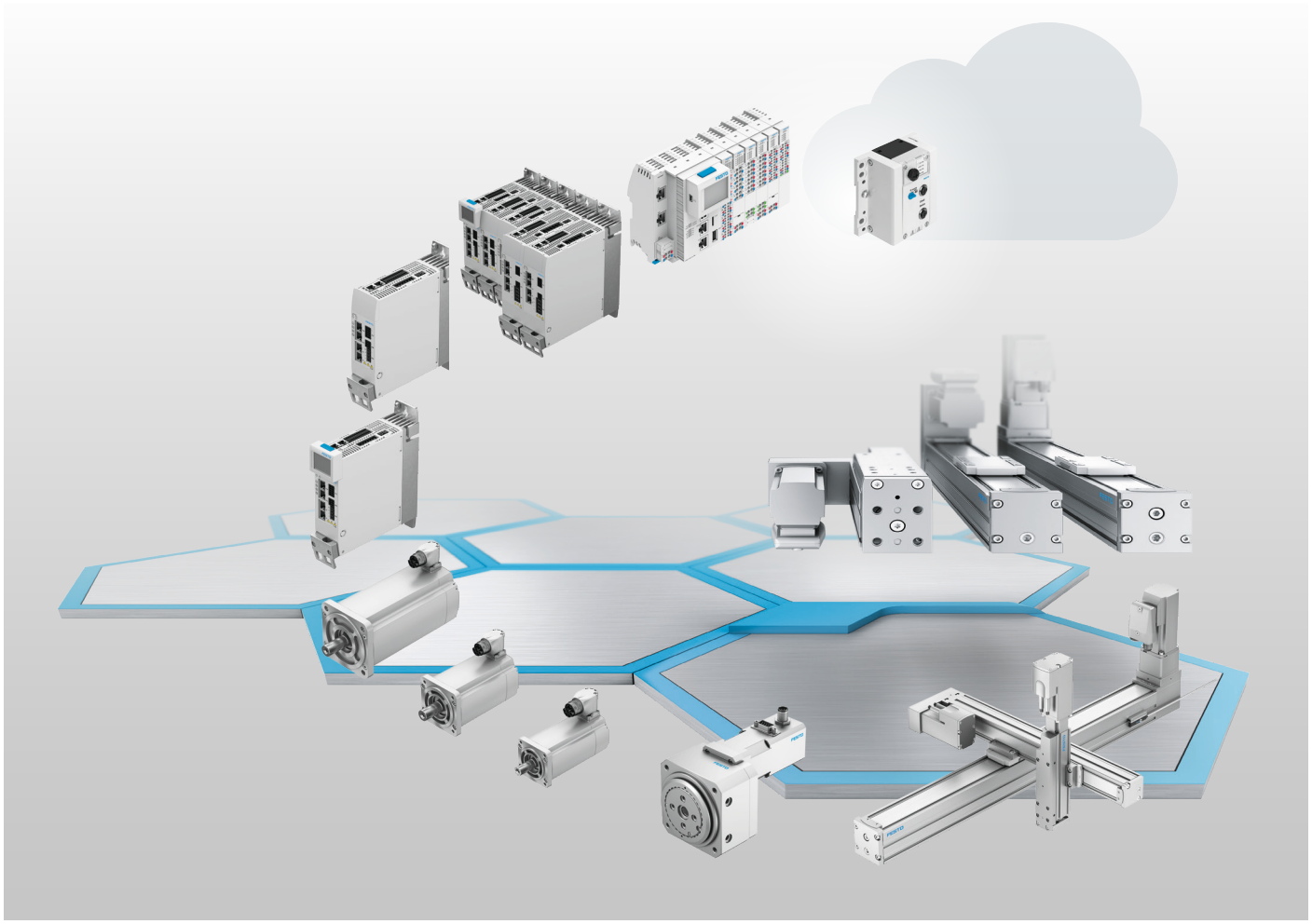
Connecting the Factories of Tomorrow—Today

This white paper explores current technologies that are enhancing our connectivity today, bringing us closer to seamless connectivity tomorrow.



With the rise of the Industrial Internet of Things (IIoT), production systems are driving toward a “seamlessly connected” future, in which all mechanical, electrical and intelligent interfaces work together as one complete package—including the motors, drives, controllers and Cloud. Although we’re not there yet, this future holds exceptional promise for the factories of tomorrow in terms of higher productivity rates, better product quality and lower costs.

If seamless connectivity is the future, then “enhanced connectivity” is the here and now. Technological developments are already underway at the field level of industrial automation, distributing intelligence among devices that formerly were unintelligent. At the same time, open interfaces like the Open Platform Communications United Architecture (OPC UA) are bringing us one step closer to true device interoperability. Together, these developments have vast implications for how we design, deploy and maintain our production systems in an increasingly digital world.

This white paper will explore several current technologies, including smart pneumatic components, Internet of Things (IoT) gateways and open communication standards, that demonstrate our current era of enhanced connectivity on the shop floor. With the right changes, these technologies can be the stepping stones to a truly connected future.

Emerging Intelligence at the Field Level

In a typical factory, the production floor consists of various electromechanical components like linear devices, rotary drives, servo drives and grippers, as well as more complex mechanical systems like multi-axis Cartesian handling systems. To realize the full vision of Industry 4.0, all relevant data from production processes, including the status of these "unintelligent" devices, must be made available in real time. Smart components are the prerequisite for real-time data availability and play a critical role in the consistent and uniform exchange of information within production processes.

A testament to enhanced connectivity, many formerly unintelligent components now incorporate IIoT functionality, data processing and diagnostic capabilities, rendering them smart. These new local functionalities bring multiple performance benefits to the overall operation, especially where efficiency and maintenance are concerned (see sidebars for examples).

One example of newly distributed intelligence at the field level is the Motion Terminal VTEM—the first valve that makes pneumatic functions available through motion apps. Designed with enhanced connectivity in mind, it enables users to quickly and easily adapt to changing process parameters in a way that improves production flexibility compared to "hardwired" technologies. It also integrates intelligent sensors for control, diagnostics and self-learning tasks, eliminating the need for additional components.

The Motion Terminal VTEM provides the functionality of traditional 2/2-, 3/2-, 4/2- or 4/3-way valves, as well as proportional technology and servo-pneumatic functions. At the same time, users can perform motion tasks using a single valve type, integrating complex movements, variable positioning and preset travel time all in one device. Other smart functions of the Motional Terminal VTEM include:

- **Energy-efficient apps.** The Motion Terminal VTEM includes an "ECO drive" motion app that automatically reduces pneumatic energy to the level required for movement. As a result, it keeps energy consumption to a minimum for simple motion tasks that don't need additional end-position force.
- **Leakage diagnostics.** By detecting leaks at an early stage, the Motion Terminal VTEM increases process reliability and productivity. It also reduces unnecessary energy losses.
- **Condition monitoring.** Thanks to this capability, the Motion Terminal VTEM reduces the lifecycle costs of systems. It also facilitates a faster return on investment (ROI) and makes you more competitive in the market.

With its combination of traditional valve technology and digital motion apps, the Motion Terminal VTEM replaces over 50 individual components—all while improving manufacturing flexibility, reducing system complexity and enabling new data analysis and condition monitoring capabilities at the field level.

How IIoT Functionality Improves Maintenance Processes

Implementing components and machines with smart functionality goes a long way toward avoiding unwanted downtime. Picture a machine working on a Friday evening after everyone had already clocked out. This machine detects an anomaly—an increase in friction, for example—on a pneumatic actuator, and then calculates that the part will fail in the next three to four days. Without any human intervention, the machine talks to the tool crib about inventory and places an order for a spare part after learning it's not currently in stock. At this point, the purchasing manager receives a simple email alert on his smartphone, asking him to approve the order. Once Monday morning rolls around, the machine calculates that the actuator is now at 80-percent failure and automatically moves the maintenance appointment to earlier in the week after the part arrives.

This example demonstrates the power of machine visibility, especially during periods of unattended operation, and also shows how the addition of simple IIoT functions can transform unplanned, costly downtime to just a few clicks on a device.

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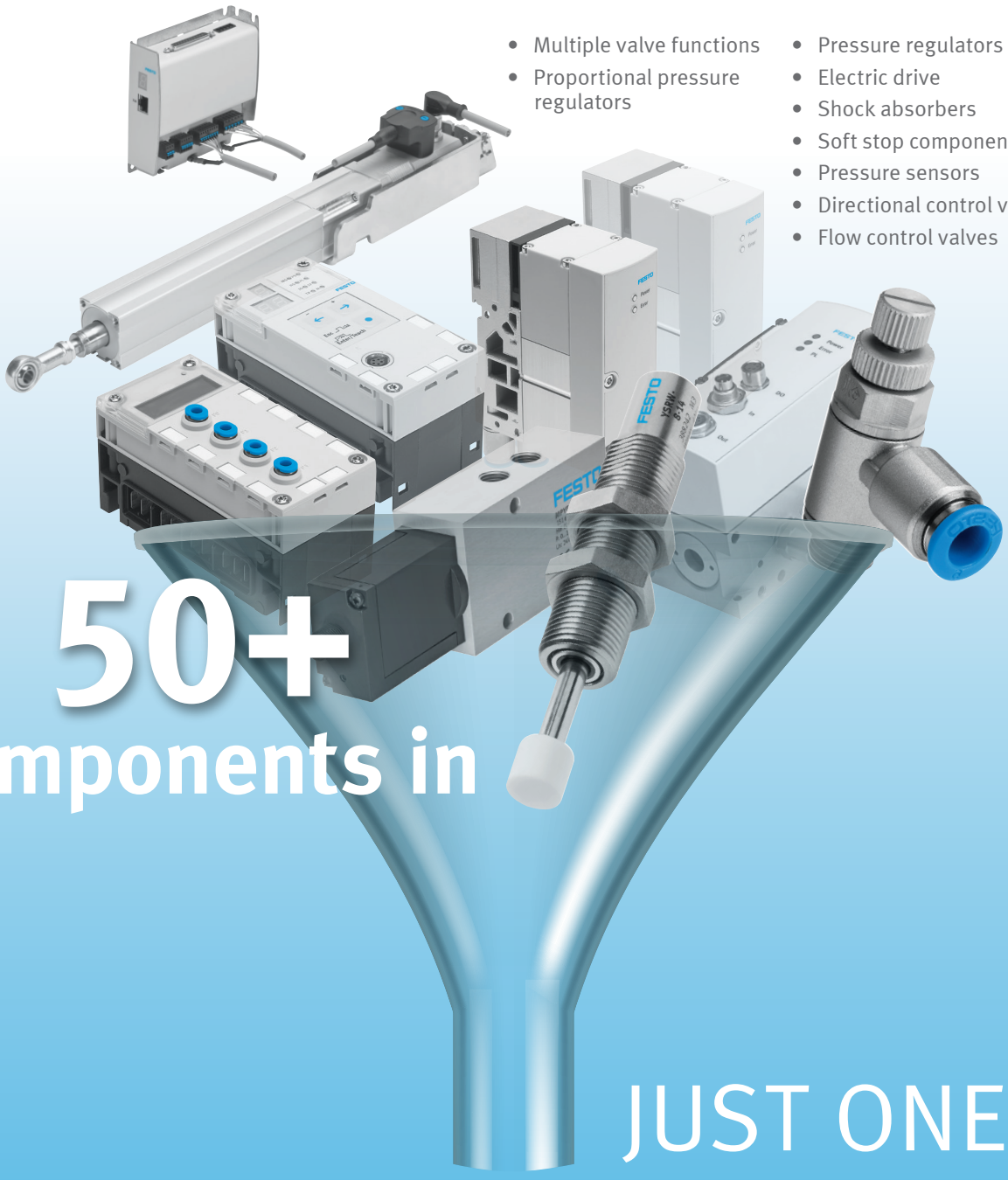
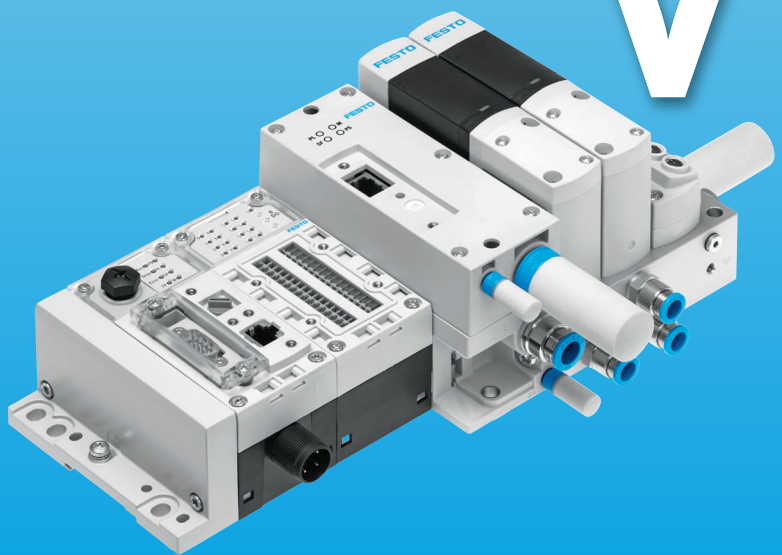


- Multiple valve functions
- Proportional pressure regulators
- Pressure regulators
- Electric drive
- Shock absorbers
- Soft stop components
- Pressure sensors
- Directional control valves
- Flow control valves

50+ components in

JUST ONE VTEM

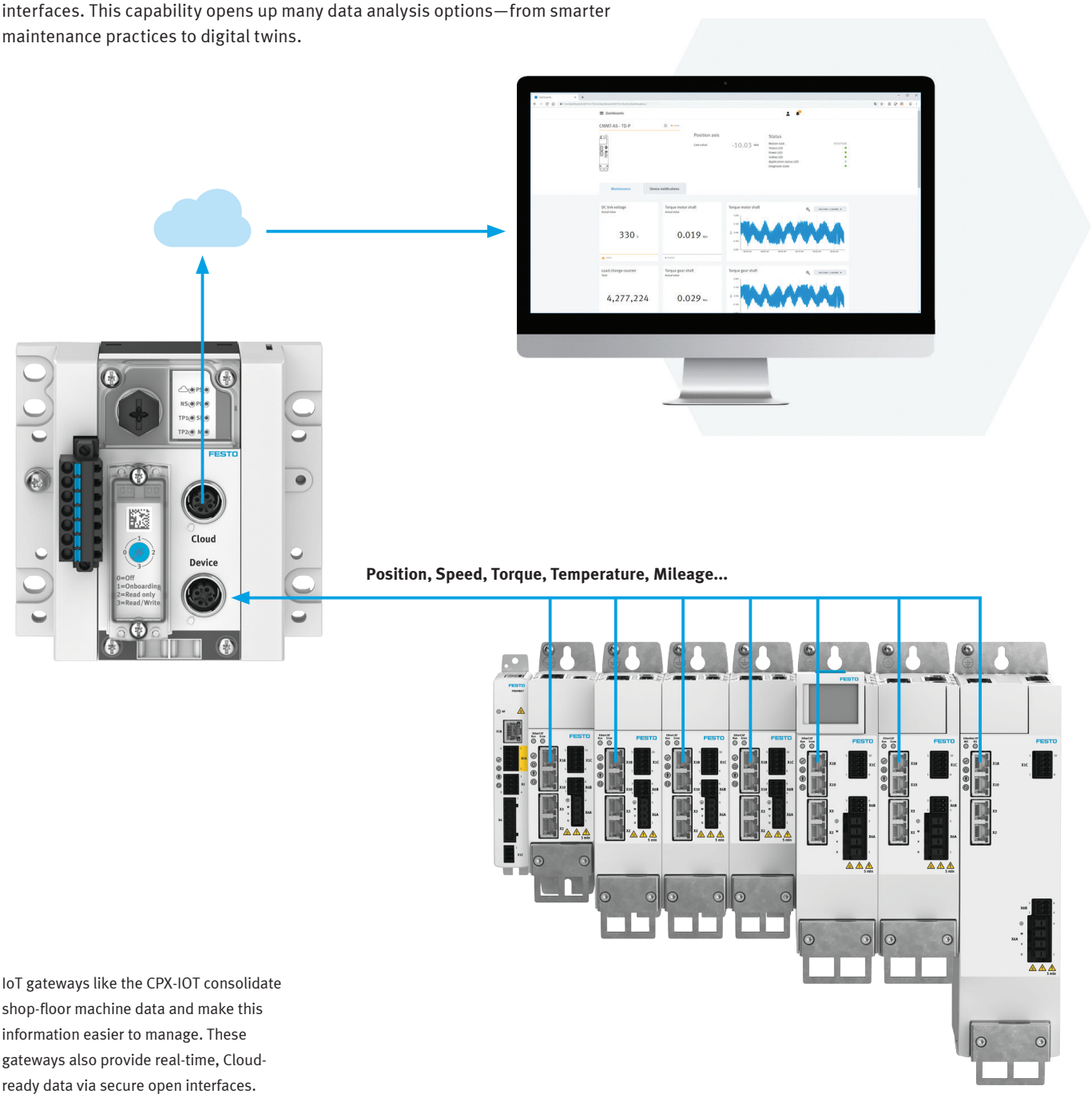


Motion Terminal VTEM replaces over 50 components with one piece of hardware that combines the benefits of electrics and pneumatics

Facilitating Component Integration With IoT Gateways

One of the biggest challenges to implementing the seamless connectivity vision is the integration of networked components and systems. Traditionally, integrating servo drives and controllers from different manufacturers is a complex and laborious task, driving up both engineering time and costs. In addition to changes in software and hardware platforms, software engineers face different fieldbus systems, software modules and data protocols that require them to master several programming languages. They must also understand how individual components behave in relation to one another. In these situations, electromechanical drive systems can take a long time to de-bug, and any technical difficulties that arise during commissioning can cause unscheduled production delays.

A step in this direction, IoT gateways like the CPX-IOT enable users to connect drives and other components for visibility into various operating parameters, including temperature, speed, voltage and more. The gateway not only consolidates machine and production data, but it also makes this information easier to manage. Depending on the complexity, users can connect up to 31 components and modules at the shop-floor level. They can then receive real-time, Cloud-ready data via secure open interfaces. This capability opens up many data analysis options—from smarter maintenance practices to digital twins.



IoT gateways like the CPX-IOT consolidate shop-floor machine data and make this information easier to manage. These gateways also provide real-time, Cloud-ready data via secure open interfaces.

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Open Protocols for Device Interoperability

Whether for mechanical or control systems, an overwhelming number of products, components and solutions are available from different manufacturers—each one with its own interface, hardware, programming language and communication protocol. As mentioned earlier, machine builders and engineers often spend a lot of time integrating these various components into their machines. Fortunately, new open communication protocols are paving the way for true device interoperability in connected environments.

One example, IO-Link, provides a new standardized I/O technology interface that expands fieldbus and Industrial Ethernet systems. In addition to transmitting process data, it lets users download parameter data from the control system to the sensor or actuator, and then send diagnostic data back to the control system. Whereas integrating a fieldbus interface down to the lowest field level used to be a costly endeavor, IO-Link transmits digital or analog values with only a simple three- or five-wire cable.

A second example, OPC UA, is a vendor-neutral software interface that transports machine data, including process values and measurements, and then describes that data semantically in a machine-readable way. Because OPC UA works independently of the operating system, it provides an open communication solution from front-end devices, sensors, actuators and controllers right up to the cloud. In addition to bringing the industry closer to true "plug and play" functionality, this interface enables the seamless integration of components—allowing them to talk to each other, as well as gather and exchange data easily.

To reap these benefits, suppliers of factory automation solutions are increasingly adding open interface compatibility to their components as a way to provide seamless communication between front-end devices, controllers and the Cloud. For example, Festo has already embedded OPC UA into its valve terminals, enabling plant managers, engineers and operators to realize the benefits of smart manufacturing. When paired with IoT gateways like the CPX platform, operators can quickly and easily collect device information and statuses via an Ethernet connection and OPC UA protocol. From there, the system can then send that information to the Cloud via a second Ethernet connection and IoT protocols, such as Advanced Message Queuing Protocol (AMQP) or MQ Telemetry Transport (MQTT).

A Glimpse Into the Future: Using IIoT Data to Inform Production

This scenario explores how IIoT data on consumer trends can inform production schedules—and is one of the many ways the larger digital world can be reflected on the shop floor. Imagine an electronics company that uses popular social media platforms to analyze data related to smartphone usage. The company can monitor how many people are watching videos on the phones, and then aggregate and analyze this data to create a production forecast based on trending models or colors. This kind of information is especially helpful if there is no historical data to guide the production of new goods or services.

The Road Ahead

As connected technologies continue to take off, factories are moving toward a future in which all components, controllers and the Industrial Cloud are seamlessly integrated, yielding countless production benefits. Although progress is well underway, we are not quite there yet. The last mile will require a continued drive to tie together formerly siloed systems, to embrace open communication standards and to fully implement digital strategies, from the shop floor to the enterprise level.

To learn more about putting IIoT into practice, please visit www.festo.com.

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