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Digital transformation tools improve plant sustainability and maintenance

It's in a facility's best interest to **prevent issues** before they arise

Many manufacturing segments are paying critical attention to energy consumption, sustainability and effective use of digital transformation tools to control costs and eliminate wasteful energy usage.

It's been estimated that some industrial facilities spend nearly a third of their energy use budgets to generate compressed air for a broad range of applications. Unfortunately, poorly maintained and operated systems can allow a measurable portion of that compressed air to leak away — wasted rather than used to actuate processes.

A component allowed to degrade over time, or whose setup isn't fully optimized, can cause compressed air leaks. In turn, processes that have insufficient pressure can consume more compressed air than they need, resulting in negative impacts on process repeatability and quality.

One way to address this challenge is through predictive maintenance practices that identify components that may be about to fail or start leaking before they fail. Preventive maintenance can locate leaks early and calculate proper pressure ratios while maintaining cycle time. To do this requires having the right information at the right time.

However, many operations don't know where to start, because they may not have resources or tools in place to access that information at any time, let alone the right one. Operators, technicians or third-party maintenance contractors may manually collect periodic measurements of equipment condition, but this information may not be timely and runs the risk of human error. If the manual reporting is accurate, the resulting spreadsheets or one-off reports are often stale by the time they're used to make decisions. As a result, the actual condition of their assets may never be accurately documented, allowing leaks to go undiagnosed and air con-

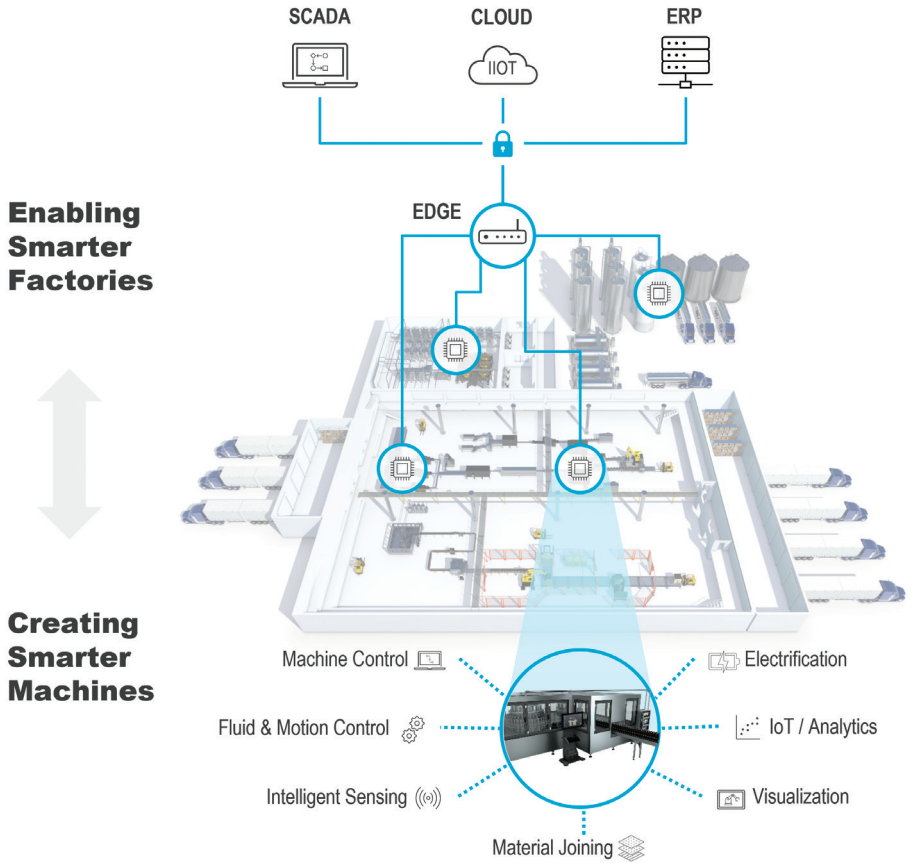

FIGURE 1: A comprehensive portfolio of devices, connectivity tools and analytics capabilities enable digital transformation across a machine, system or an entire facility. Courtesy Emerson

FIGURE 2: A flow sensor can continuously monitor airflow in pneumatic systems, providing operators with clear, actionable insights regarding flow, pressure and temperature. Courtesy Emerson

sumption to increase unchecked. When maintenance is performed, it's "breakdown maintenance," or fixing equipment when it fails or replacing components on a time rather than health basis. This approach virtually always incurs higher costs and unplanned downtime and negatively impacts a plant's overall energy efficiency and sustainability goals.

Technology now exists that offers a better way. Through the digital transformation of pneumatic systems, compressed air consumption can now be monitored in real time to provide valuable, actionable data and insight facilities can use to optimize pneumatic processes and guide effective predictive maintenance efforts. By using intelligent technologies to make better decisions and take immediate action, compressed air consumption can be significantly reduced, better predictive maintenance can be implemented and sustainability efforts can be improved.

> **Through the digital transformation** of pneumatic systems, compressed air consumption can now be monitored in real time.

Pneumatic technology transformed

Digital transformation is still new to some and may seem abstract or ambiguous. In fact, it's quite the opposite.

Digital transformation is a process that a facility, systemw or piece of equipment undergoes that allows end users to see real-time data, make decisions based on it and act based on those informed decisions — creating smarter machines and systems to enable smarter operations. Quite simply, digital transformation places the right information in front of the right expert at the right time. It eliminates guessing about process parameters or waiting for equipment to fail.

The industrial internet of things (IIoT) is one mechanism of digital transformation, enabling users to unlock trapped data by integrating and connecting smart sensors and instruments that allow processors to run smarter and more efficiently than ever before.

For compressed air systems, it can be as basic as adding a sensor that measures consumption or as elaborate as connecting an entire line or floor. Both cases open previously inaccessible levels of compressed air data and asset condition, affording operators a clearer understanding of the current, past and possible future state of their pneumatic system. This expertise empowers them to confidently make informed decisions and take quick action.

By using technology to automate and optimize operational processes in this way, facilities put a continuous cycle into motion. This cycle has three stages: See, Decide and Act. In compressed air applications, different smart solutions automate each stage.

See Stage: This stage sets off the cycle, starting at a sensor that creates the appropriate data in a continuous, repeatable and reliable way. In pneumatic systems, this process includes capturing the acceleration and cycles of pneumatic valves and cylinder actuation, as well as measuring the volumetric flow rate, pressure, temperature, mass flow rate and flow velocity of compressed air. Such real-time data provides around-the-clock information about the actual health of a facility's assets and energy consumption and is the foundation for timely, informed decision-making.

Decide Stage: In this stage, the sensor delivers the collected data to a controller or gateway device that continuously aggregates that information in real time and presents trends through an easy-to-interpret visualization tool. At-hand expertise like this empowers operators to make quicker, smarter decisions that drive faster, appropriate actions.

Act Stage: Mobility tools used in this stage send notifications to specific personnel that prescribe clear, necessary actions to take based on the current

FIGURE 3: This dashboard for pneumatics applications offers a picture of a facility's pneumatic system performance in one screen, enabling quick, informed decision-making that makes predictive maintenance possible. Courtesy Emerson

state of operations. This can include which cylinders are approaching end of life, have an increase in acceleration over time or have already moved past their targeted cycle time. These directives enable personnel to resolve issues before they can slow or shut down operations.

Together, these stages offer valuable analytics; their endless cycle generates a technology loop that enables predictive maintenance while continuously improving expertise and energy efficiency.

Prevent unplanned downtime

Maintenance is inherent to all industrial facilities. In pneumatic systems, valves wear out over time, causing leakage that leads to excessive compressed air consumption. Some systems can have many valves, which can make identifying a faulty one challenging. Leak troubleshooting can be time-consuming and, with the ongoing labor shortage and skills gap, maintenance personnel may already be stretched thin. There may not be enough staff to keep up with what must be done, and historical knowledge may not exist. When production must stop for repairs, it can be very expensive. For mid-sized food and beverage facilities, unplanned downtime costs around $30,000 per hour.

It's in a facility's best interest to prevent issues before they can arise. That's where predictive maintenance comes in. Predictive maintenance can significantly decrease operations and maintenance costs and eliminate unplanned downtime.

Now that we know how the See-Decide-Act cycle works, it's easy to imagine how the digital transformation of a pneumatic system makes predictive maintenance possible. Let's consider pneumatics maintenance in food and beverage processing, where compressed air is heavily used to actuate auxiliary and hygienic valves through discrete pilot valves or valve systems.

Auxiliary and hygienic valves can be used to heat, cool, dose or fill additives and ingredients to sanitary valves that transport consumable goods or beverages. Connected smart sensors, controllers and edge gateways capture a more complete picture of valve health, enabling the system to detect when valves are worn or nearing the end of their service

3 Fast Facts

- **According to Wikipedia,** pneumatics is a branch of engineering that makes use of gas or pressurized air. Pneumatic systems used in industry are commonly powered by compressed air or compressed inert gases. A centrally located and electrically-powered compressor powers cylinders, air motors, pneumatic actuators, and other pneumatic devices.

life. If such a valve is detected, the system immediately sends an alert to maintenance personnel, who schedule planned maintenance.

The ability to predict potential problems before they occur helps reduce unplanned downtime while real-time root-cause analysis clearly prescribes the appropriate action to take. Automated troubleshooting and analytics further reduce maintenance time, increase equipment availability, improve productivity and, in the case of leaks, save energy.

A low-barrier approach to digital transformation can focus on one key domain or challenge — even one machine — then use lessons learned to scale up.

Sustainability goals, optimizing energy

Today's smart pneumatic devices provide a more complete picture of pneumatic system performance. This gives facilities a better understanding to effectively control energy use by locating and diagnosing leaks and optimizing compressor system pressure.

Compressors consume a lot of energy to operate, and that amount is often more than needed for normal operating conditions. It's estimated that 20% to 30% of a typical facility's energy consumption goes to producing compressed air. When mid-sized facilities often spend $2.5 million a year on energy, any reductions in compressed air consumption can equal substantial savings. The more a facility can track leaks and balance an operated valve, the greater control it has over its energy use. Optimizing the compressed air a valve consumes while still achieving the required cycle time limits the amount of work the compressor must do and allows it to only consume the energy it truly needs to do it.

By digitally transforming their pneumatic systems to diagnose leaks and calculate proper pressure ratios, facilities can typically see a reduction in compressed air consumption and energy costs.

Moving forward

Digital transformation should be an ongoing process. No matter how much smart technology a facility has introduced into its production systems, upgrading systems to the latest generation of digitally enabled pneumatics lays the groundwork for better insight and control of compressed air usage. One way to move forward with pneumatics transformation is through a workshop with a comprehensive pneumatics solutions provider that offers proven expertise, sensors and hardware. Expert solutions providers can work with a facility to identify issues and prioritize solutions to implement. Each production system and facility is different; digital transformation works best when it's developed on a case-by-case basis, working closely with a proven provider.

Some operations may resist or postpone moving forward with digital transformation due to perceived cost and disruption concerns. The answer to those concerns is: "start small, scale fast." A low-barrier approach to digital transformation can focus on one key domain or challenge — even one machine — then use lessons learned to scale up. There are technology providers that offer complete, vertically integrated solutions that combine components, sensors and controllers, as well as analytics packages designed to enable facilities to benefit from digital transformation at the level that best fits their unique requirements. For facilities that are farther along, providers offer solutions that combine existing sensor and controller infrastructure with edge analytics, too.

Digital transformation can rapidly offer significant return on investment through better information and decision-making. Using a See-Decide-Act pragmatic approach helps facilities kickstart their journey. The result: real-time information is collected and converted into useful analytics and insights to guide and improve predictive maintenance practices and optimize energy use. PE

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