Pneumatics and the IIoT

Emerson's Enrico De Carolis, global technology vice president for Fluid Control and Pneumatics, explains how pneumatics is already established as an advanced technology that lends itself well to the Industrial Internet of Things (IIoT).

Sensors have become smaller, more lightweight, and easier to use in various pneumatic components, allowing measurement of temperatures, pressures, flow rates, cycle times and valve response rates. Even the simplest devices can provide crucial information.

Machine builders in many industries are responding to the IIoT's growth by adding data gathering sensors to their equipment, with the resulting data made available for analysis and, as systems become more advanced, converted into actionable information. Rather than a revolution, manufacturers are finding that the IIoT is more a gradual evolution toward smart components, machines and systems that has been taking place over the past few years.

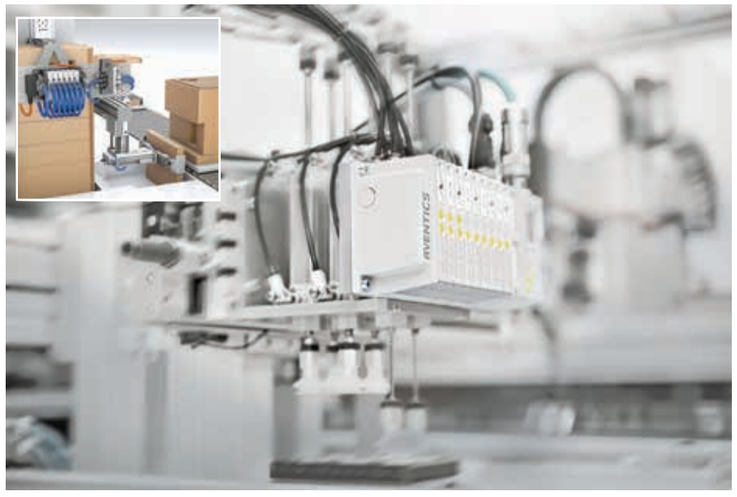
Pneumatics is already established as an advanced technology that lends itself well to these new capabilities, giving companies a deeper understanding of their equipment's actual operational performance. For example, OEMs can use pneumatic capabilities to monitor a pneumatic system's operating state, analyse that data, and report on its operation, resources used, energy efficiency, and much more. The same sensors can also provide reliable information on actuators, valves, and other devices without involving the machine controller.

In addition, machine builders can leverage IIoT capabilities to improve pneumatic components' extensive diagnostic abilities to measure critical parameters including cylinder velocity. This provides predictive maintenance information to prevent unplanned downtime.

Pneumatics offers several key benefits in an IIoT environment, including:

- Predictive maintenance is where pneumatic IIoT capabilities truly shine. By using appropriate data from IIoT sensors' analysed data, for example, technicians can predict that a shock absorber at the end of an actuator is deteriorating by noting an increase in its stroke speed, even if only by a few milliseconds.
- With respect to safety, the IIoT is enabling pneumatic systems to use new capabilities in tracking and measurement. These provide great insight into machine operation and component and subsystem performance. With these insights comes a richer opportunity to monitor machine safety and better protect people and equipment from harm.
- IIoT-enabled control components such as smart pneumatics generate component-level data that makes calculations of a production system's overall operational efficiency (OEE) and total cost of ownership (TCO) more accurate.
- Energy efficiency is a critical component of IIoT's appeal to manufacturers. An IIoT edge gateway helps users determine the location of possible leaks and to determine the optimal operating point, matching the work to be carried out with the appropriate amount of energy supplied.
- More and more businesses support late customisation of their products. Changeovers and product variations are more frequent and this calls for manufacturing equipment that can change without sacrificing quality. Machinery can be designed to easily and seamlessly supply different pressures for different tooling positions and sequences, enabling various parts be processed on the same machine.

A smart pneumatics monitor module, this one from Aventics, provides users with reliable information on the state of wear of pneumatic actuators, valves, and other devices, as well as the energy efficiency of pneumatic systems.



Pneumatics lends itself well to new IIoT capabilities. For example, it can let packaging companies know more about the performance of pneumatic equipment on the packaging line.

IIoT sensing and measurement

Pneumatics circuits already contain sensors for feedback, but now they can be monitored by IIoT-enabled devices. Sensors can measure temperatures, pressures, flow rates, cycle times, position, valve response rates, and more. IIoT-enabled sensors can measure pressure losses, for example, and send alerts when leak rate exceeds a predetermined value.

The highest levels of manufacturing quality require constant monitoring and relentless control over every production step. Companies building automotive components want to know the exact forces, pressures and positions of a pneumatic cylinder driving a bearing installation tool. They want sequences documented so they can determine months later if components are being made with the same precision as the first ones off the line.

Open, high-performance, globally available communication protocols are vital for the IIoT. Deterministic control protocols have been around for decades. However, these protocols were designed for real time I/O (control) data, not necessarily for diagnostic and prognostic information generated and used by IIoT devices.

OPC Unified Architecture (OPC UA) is the OPC Foundation's data exchange standard. It builds on previous OPC protocols to ensure secure, reliable manufacturer- and platform-independent information transfer. OPC UA allows easy access to various device data from authorised applications without disrupting the network infrastructure's deterministic real time I/O (control) data.

Now standardised in IEC 62541, OPC UA architecture is particularly versatile and flexible and offers access to data carrying historical information, along with base services for data access, alarms, and events. These services can be supplemented with information models (for fluid technology, for example), and for custom, manufacturer-specific functions and information.

Pneumatics manufacturers such as Emerson have also developed edge computing gateways that aggregate, analyse and report key performance metrics from several pneumatic devices. These can be used by end-users and offers competitive advantage to machine OEMs by letting them use their equipment's IIoT-support capabilities anywhere in the world.

Edge computing gateways make it easier to implement IIoT solutions by operating independently from the existing control architecture and using OPC UA, MQTT, e-mail and other pathways to deliver prognostic alerts for system-and device-level performance data to a local server or an offsite cloud.

This Aventics ASCO 502 Series valve could be the basis for a host of IIoT applications as it is modular design with all relevant fieldbus protocols, consistent communication up to the valve, and an integrated web server.

The Aventics ASCO 502 Series valve can process a large variety of signals, including analogue and digital I/O modules, analogue combination modules, control modules, and pressure measurement modules.

Bringing IIoT to life

By accessing the electronics on valves an IIoT gateway lets pneumatic manufacturers evaluate valve life by tracking the valve's cycle counts. A cycle-counter algorithm can then be used to determine what percentage of a valve's life cycle is gone and predict how much is left. This lets proactive users schedule predictive maintenance and avoid unplanned downtime.

Pneumatic cylinders often use external shock absorbers, especially when quickly moving large loads. But worn shock absorbers can increase wear and vibrations in pneumatics. An IIoT edge computing gateway can use end-of-stroke sensor signals to evaluates cylinder deceleration. Now, customers no longer need to replace shock absorbers simply as a precaution. As soon as a critical value is reached, an alarm message is sent out triggering maintenance to replace the shock absorber before it fails and affects production.

Data is only useful when it becomes information that provides insight, guides decisions, or helps justify investments. To achieve IIoT's full potential, component manufacturers, OEMs, and end-users must communicate and collaborate for the common good. The ultimate result: a data-rich environment established by IIoT-enabled technology that provides real-world, real-time, actionable information about manufacturing and industrial systems, information that is readily usable to help solve challenges and better satisfy business goals. ❑