Factors Driving Expansion of IoT

A digitalized and highly connected world offers many potential opportunities—one challenge is to make the most of those opportunities. The rich data generated by IoT technology offers new ways to solve fundamental challenges many industrial operations and manufacturers face on an ongoing basis.
**Process monitoring and control:** The highest quality manufacturing is achieved through relentless control of every single step in a production process. Companies building components for automobiles, for example, want to know exactly the force, pressure and position of a cylinder driving an actuator that is placing a bearing in a product – and they want that sequence documented so they know that, 50,000 parts later, it was manufactured with the exact same precision as the first part off the line.

If there is deviation in the data points generated by the pneumatics devices as they operate, that data can indicate issues with the actual device. It can also be an indication of other issues: pressure loss in the air supply system, the bearings being placed are not properly manufactured, or the devices feeding the bearings, or the components are losing synchronization for some other reason such as component degradation or need for maintenance.

IoT-enabled pneumatics technology can also enhance manufacturing flexibility. More and more businesses are working to support mass customization of their products. Changeovers and product variations are more frequent, which requires manufacturing equipment to be able to change as well without sacrificing quality.

With modern connected products, a system can be engineered to easily and seamlessly supply different pressures for different tooling positions and sequences for flexibility. For example, the AVENTICS AV pneumatic directional control valve system with its Advanced Electronic System can provide easy, on-the-fly pressure changes and tooling positions for quick product variations for changeovers.

**Predictive maintenance:** IoT technology provides the kind of data manufacturers need to maximize uptime through intelligent predictive maintenance processes. If the pneumatics fail or begin malfunctioning due to poor maintenance, productivity can suffer, and unscheduled machine downtime becomes problematic.

Pneumatics manufacturers like AVENTICS working with automation OEMs have developed enhanced approaches to both predictive and preventive maintenance practices by enhancing the technical features of their pneumatics systems. These enhancements, including new sensors, IoT hubs and other digital capabilities, align with the emerging requirements to provide more data-driven approaches to maintenance.

In addition, pneumatics manufacturers like AVENTICS constantly invest in new designs and improved materials to increase the reliability and operational lifespan of their products. These include better valve sealing techniques, using components made with polymer for better wear profiles and improvements to airflow paths, making devices run smoother and more efficiently.

**IoT EXAMPLE 2**

**Energy efficiency – detecting leakages**

Energy efficiency is a key economic factor. An IoT hub gives a clear indication of where and how compressed air consumption changes – and allows users to determine the location of possible leakages. Predictive diagnostics is one of the main arguments for efficient use of an IoT hub (see page 4 for an example of an IoT hub).

---

**Example 2:**
- Increase in consumption only when valve is actuated -> Anomaly/leakage on or downstream of valve
- Overall increase in consumption -> Anomaly/leakage in supply or upstream of valve

---

AV03 & AV05 pneumatic directional control valves with Advanced Electronics System (AES)
Return on investment: The ultimate value of any technology is how using that technology enhances the bottom line and pays back its cost. Data is necessary to calculate this: Industrial operations and manufacturers need to be able to capture and track a host of measurement points about individual machines as well as production lines and roll that data up into assessments of productivity, efficiency, uptime and production costs.

IoT-enabled components like pneumatics now generate that component-level data within production machines that can contribute to making quantitative statements about a production system's Overall Equipment Effectiveness (OEE).

The lightbulb moment: Data as competitive advantage
Many manufacturing and industrial end users express eagerness to go full bore on implementing IoT technology. So, what's holding us back?

For those responsible for maintaining machines and keeping them running, the path is very clear. You can have an IoT system provide data from the machine and ensure that the systems or the components on that machine are working within their normal range. In that regard, the end users are the ones pushing for IoT implementation.

The disconnect is often with machine builders. They may have multiple customers pushing them for IoT solutions, so OEMs are asking, "How do you implement that? Who has the product to do that? And what should we be monitoring?"

Pneumatics has had different diagnostic features for some time. For example, we can sense today whether the power is too low or too high, or whether there is a short circuit in an I/O system that caused some sort of failure. And now we are taking it a step further with sensors and the ability to use I/O systems to look at the things that are driving the actuators.

The aspect that people are struggling with is, "I have all this data, but what does it mean? How do we turn that data into useful information?" As we have worked with both OEMs and end users and demonstrated how data can be captured, aggregated and formatted to be useful, we’ve had more than one opportunity to see “lightbulb moments” where the potential can be turned into reality. A suggestion to get started is to begin with a critical machine area and develop an IoT strategy around improving the process. For example, what are the top five challenging component areas?

Now, the focus needs to be on what end users can do with that data to convert it into useful information and react to issues and improve performance. For example, the AVENTICS ST4-2P programmable sensor has been in our product line for years. It measures travel distance and velocity for pneumatic cylinders. We can sense the velocity of the piston in the cylinder.

But we can also use that data coming back from the sensors to monitor the cushions and shock absorbers inside the cylinder to ensure they are performing within a certain specification window. If you interpolate that data, you can come up with a way to ensure the cylinder is performing as expected, and quickly determine when it is not.
A Hub for IoT Data
As pneumatics become more intelligent, they are generating additional data points across the production systems in which they are installed—information such as diagnostics, usage statistics and lifetime data. However, device data is only valuable when used to manage production systems to achieve greater productivity, control energy consumption and maximize uptime.

In addition, if all the pneumatic components (along with other intelligent machine drives, devices and subsystems) are generating megabytes of performance data, there’s a potential to overwhelm the machine control bus and complicate automation command and control performance. To address this scenario, AVENTICS has developed a “hub” that aggregates and organizes pneumatic performance data and can deliver it through separate pathways to plant management systems. Called the Smart Pneumatic Monitor (SPM), this hub can be independent of the process control architecture, using OPC UA, MQTT, FTP or email pathways to deliver alerts and both system-level and device-level performance data.

To monitor the wear of a shock absorber, for example, the SPM breaks down the end switch signals to evaluate the cushioning sequence. Algorithms written by AVENTICS based on the company’s application experience analyze this data internally and send the information either to defined people or to the parent MES or ERP systems via the OPC UA interface.

AVENTICS has a live, online demonstration of this IoT hub capability at readyforiot.org.

Multiple AVENTICS devices are cycling through motion sequences, and the SPM is aggregating and reporting key performances metrics in ways that can be useful for end users and that OEMs can highlight as a competitive, IoT-supporting capability of their production systems equipped with this technology.
Turning Data into Information

Data is only useful when it becomes information that provides insight, guides decisions and planning and helps justify investments. To achieve the full potential of IoT, component manufacturers, OEMs and end users need to communicate and collaborate for the common good.

Both the OEM and the component manufacturer have the responsibility to address problems that are uncovered from the data. There is some consultative nature to it. OEMs and end users typically would like to have some additional monitoring to make sure that their machine processes are being controlled correctly. We can work with the OEM to come up with an IoT architecture to make sure that the appropriate sensors are in place and sensing the right process parameters to help keep that machine running full time.

The important thing is that the component manufacturers outfitting the machine need to talk to one another and understand how all the different IoT-enabled devices come into play so there can be a true partnership when talking to customers about IoT. The key is knowing how the data is passing between those items and making sure that the data gets wherever it needs to go, whether that is locally on a web server or out to a cloud system.

The ultimate result: The data-rich environment that is being established by IoT-enabled technology can provide real-world, real-time, actionable information about their production and industrial systems, information that is readily usable to help them solve their challenges and better satisfy their business goals.