How the Industrial Internet of Things is revolutionising fluid handling

Optimising flow control in the digital age

The Industrial Internet of Things (IIOT) has been heralded as a great enabler that will revolutionise manufacturing and processing. Although asset-heavy industries were slow on the initial uptake, as the cost of sensor and network development declines it is becoming more feasible to outfit industrial equipment with devices to capture and communicate data. An emerging era of smart industrial equipment will unlock new opportunities to enhance process efficiency, sustainability and safety in flow control applications.

Bringing legacy assets online

Developing a robust strategy to meet the increasing demand for smart equipment can be complex. Careful consideration and planning is required to ensure the upgrade or replacement of existing assets is effective and has longevity.

Much of the time, legacy assets associated with flow control and fluidics – such as valves, pumps and metering devices – are performing their original intended function perfectly well. Nevertheless, they are increasingly disadvantaged through a lack of integration with other equipment. They need to be brought online to unlock remote monitoring and management capabilities and to achieve integration with wider business process management systems.

Legacy equipment can be upgraded with the addition of sensors that monitor key performance parameters and convey this data to a central network. However, the design and integration of such sensors brings many technical challenges. Overcoming these requires a greater depth and breadth of skills and knowledge than is typically associated with the design, manufacture, installation and maintenance of the underlying equipment.

There are indications that the next decade could bring a large-scale shift towards a service-led approach

Many internal product development teams are reaching out to externally resource with cross-industry expertise in the physics of flow and sensor/algorithm design. This can facilitate the development of better, simpler and more cost-effective solutions. For instance, Sagentia worked with one client to devise a monitoring and diagnostic system for a complex water boiler application. In-house engineers had fitted a standard suite of sensors to monitor pressure and flow, temperature, motor torque, valve position and fan revs. This was effective but expensive. Sagentia demonstrated that using a single microphone and sound analysis on a local embedded microcontroller enabled 95% of boiler faults to be monitored and diagnosed at less than 1% of the cost.

Design considerations

The design of smart fluid control systems requires a broad spectrum of skills. Manufacturers that acknowledge and harness this are best placed to improve new and legacy equipment, prolonging lifespan and relevance in the rapidly evolving digital age.

Defining which parameters to monitor is the first step. It's not desirable for equipment to be covered in a forest of sensors, so understanding what information will be most useful in managing a specific application is essential.

The key is to prioritise data that can be used to leverage actionable insights. This

requires a deep understanding of the core processes and equipment features. Wider factors unique to the application also need to be considered, especially if the equipment performs a critical role or operates in a harsh environment. For instance, sensors can be programmed to monitor external factors which have a bearing on equipment performance and lifespan, such as contamination of the process medium or exposure to extreme temperatures and vibrations.

Every action performed by a piece of equipment can be summarised with a parametric model. Sensors are configured to monitor these parameters over time, and a diagnostic algorithm can be incorporated to trigger an alert if there is any significant deviation from the norm. Data fusion can bring additional benefits here. Using two or more sensors in combination gives richer insight than using each of them in a standalone configuration.

Well-designed smart equipment can help end users work proactively to mitigate against known risks of failure and overcome unwanted effects such as high noise levels. Empowering engineers with real-time insights into equipment performance can help them identify the best moment to intervene. This results in better control of the process, and facilitates informed decisions based on multiple factors, such as wider safety or environmental implications. Performance data can also provide insights that may be of value downstream, for instance by indicating whether the process medium may be contaminated.

A modern meter

Strategic deployment of smart machines can improve the next generation of equipment. By collecting data on the current model, it's possible to learn how it fails and any precursor warning signals. Insights can be embraced to either improve future devices, or create better alerting systems. This approach can facilitate a move from classic product sales to a service based business model, as pioneered by Rolls-Royce in its sale of 'thrust' as opposed to aircraft engines.

Integration considerations

The underlying ecosystem of connectivity spawned by the communications revolution continues to evolve rapidly. This is a double-edged sword, bringing challenges as well as opportunities.

A major consideration is interoperability between machines and devices that use different protocols and architectures. A detailed understanding of the compatibility of components, sub-systems and common communication protocols is required. Designing the sensor platform to integrate with a variety of communication protocols allows a single smart device such as a meter or an instrumented pump to be fitted with the requisite communications module, or to have that functionality built-in.

Smart equipment offers many prospects for better efficiency and cost savings. But this is irrelevant if expensive assets have their life shortened because they can't adapt to emerging business process management systems or communications frameworks. One way to combat this is to embed devices with functionality and compatibility options that may not be needed now, but can be brought online later.

A detailed understanding of global technology platforms should underpin the roll out of smart products. Effective delivery of pertinent, meaningful data to relevant stakeholders is one concern. But ensuring sensors can keep pace with inevitable changes in the wider communications ecosystem is also vital. The migration of data to cloud-hosted platforms provides an effective route to overcome compatibility and accessibility issues. However, cybersecurity is a major concern, and significant effort needs to be expended to mitigate risks in this arena.

Industry spotlight: a smart fluid control system

Last year, Sagentia was approached by a major player in the water industry regarding the development of a 24/7 smart fluid control system. A core requirement was the capture and conveyance of real-time data from a cloud service delivery platform to facilitate customer analytics. In addition, the user experience of various stakeholders, including calibration, commissioning and maintenance professionals, had to be considered.

Sagentia devised an iOS application incorporating near field communication (NFC) and Bluetooth technologies. To ensure its longevity and adaptability, 4G cellular support was embedded, as well as Low Power Wide Area Network technologies LoRa and SigFox. These come from a new family of communications technologies allowing devices to convey small volumes of data over a long distance with low power. This is an important IIOT capability, offering significant advantages over current cellular network technology for machine-to-machine communications.

This progressive solution enabled the client to take a major step forward in its capability and market offering. It created a rapid, future-proof route to out-perform competitors.

What does the future hold?

As smart devices achieve greater penetration across the fluid control industry, we are likely to see a change in the roles, responsibilities and interfaces between equipment manufacturers and end users.

There are indications that the next decade could bring a large-scale shift towards a service-led approach. For end users, this will redefine the balance between capital expenditure and operational expenditure whereas for manufacturers it will help secure retained income.

Reliable real-time monitoring could also counter the trend for 'over-design' that has affected many industrial processes in recent years. Stringent environmental and safety regulations coupled with ambitious performance targets have sometimes resulted in the unnecessary

use of exotic materials or overlapping functions. Empowering end users with better situational awareness enables them to manage flow control more proactively. This makes it easier to ensure equipment always operates within safe boundaries, reducing the need for redundancy in some applications.

A further advantage of smart, connected systems is an enhanced ability to intercept emerging problems before they escalate. The 2005 Buncefield fuel storage depot conflagration is a prime example of an occasion where early interception could have prevented a major incident. Two level control devices on a tank that was filling with petrol failed: a gauge used by employees to monitor the process stuck and an independent high-level switch intended to close down operations if the tank overfilled was inoperable. Consequently, control room staff were not alerted that the tank was filling to dangerous levels. Large quantities overflowed and a vapour cloud formed which ignited, causing a series of explosions and a fire that lasted five days. If an intelligent sensor system had been installed, staff would have been alerted as soon as the fuel gauge stuck, enabling action to be taken long before the first explosion occurred.

Monitoring flow with the Industrial Internet of Things

Intelligent sensor design is the cornerstone of informed and purposeful fluidics decision making in the digital age. It represents an effective route to boost safe, environmentally sound and profitable industrial practices. The stage is set for fundamental changes to the fluid handling industry as we know it.

For more information:
This article was written by Alun James, chief technology officer at Sagentia and Chris Covey, vice president – Industrial at Sagentia. Visit: www.sagentia.com