PROCESS TECHNOLOGY

AUTOMATION + CONTROL + INSTRUMENTATION

May 2022 vol.35 no.9

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Moore Industries' FS Functional Safety Series provides layers of protection that reduce risk and deliver reliable performance when it is most needed. The SIL2 and SIL3 capable instruments are designed and built to IEC 61508 standards for use in Safety Instrumented Systems (SIS) and feature third-party certification by exida. They offer industry-leading reliability with 20 V/m RFI/EMI protection provided by special circuit and enclosure designs which protect against the harmful effects of radio and electromagnetic interference. In addition, they can tolerate extreme ambient operating temperature ranges of -40 to 85°C allowing them to be deployed in the most demanding environments. These instruments are available in either a rugged and durable aluminium DIN-rail case or housed in a field mount explosion-proof or flameproof enclosure. The Moore Industries family of award winning instruments for functional safety applications keeps growing. It began with the STA SIL 2/3 Capable Safety Single Loop Logic Solver; followed by the SRM SIL 2 Capable Safety Relay Module; the SSX and SST SIL 2/3 Capable Safety Signal Isolators and Splitter with HART pass-through capability; the STZ SIL 2/3 Capable Safety Dual Input Smart HART Temperature Transmitters; the SFY SIL2/3 Capable Safety Frequency to DC transmitter; and most recently the SLD SIL 2/3 Capable Safety Signal Monitor and Display. All of these cost-effective solutions offer industry-leading reliability with FMEDA (Failure Modes Effects and Diagnostic Analysis) reports available upon request. Visit the Moore Industries website at www.miinet.com/safetyseries to learn more or email sales@mooreind.com.au.

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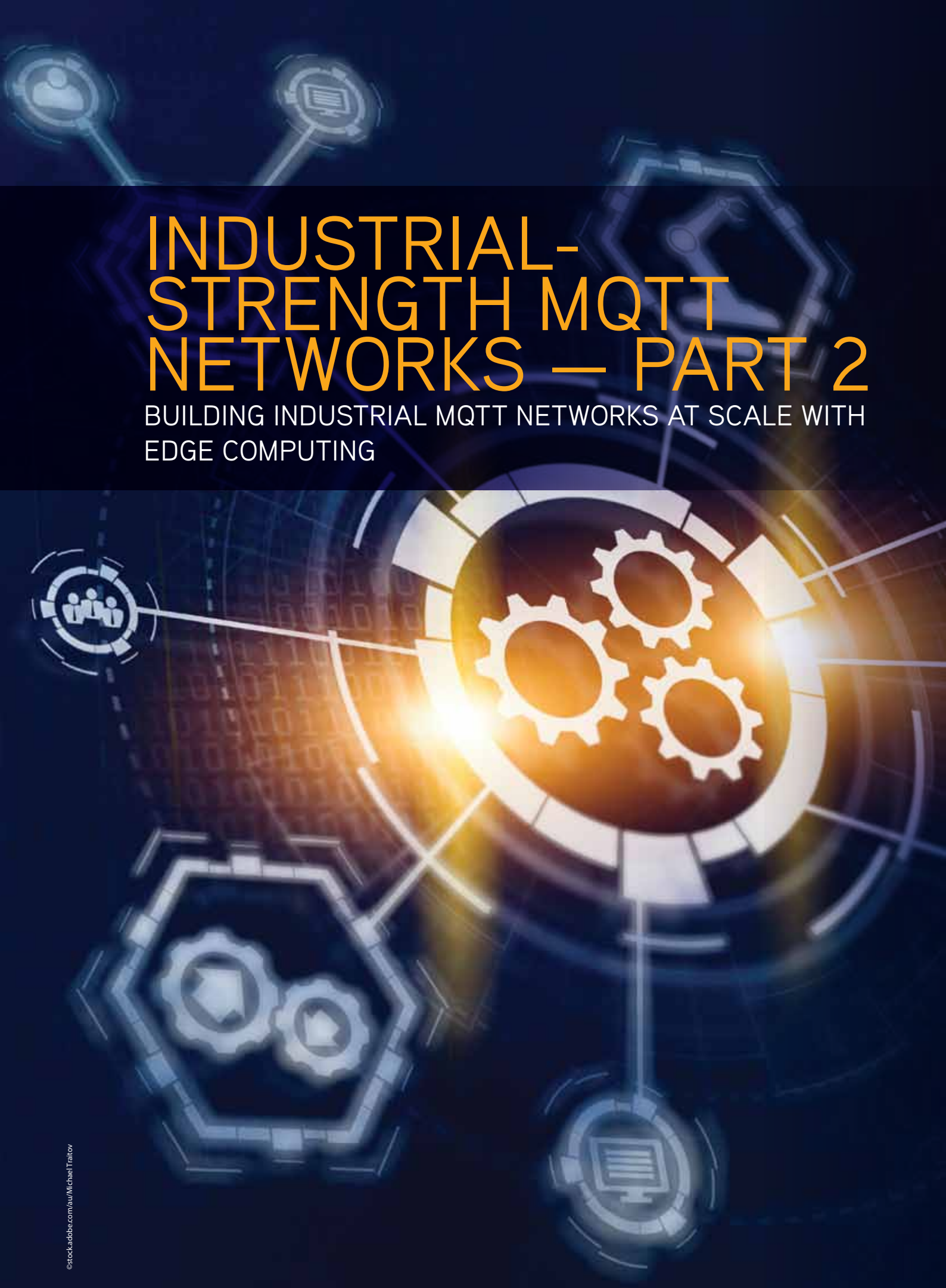
INDUSTRIAL-STRENGTH MQTT NETWORKS — PART 2

BUILDING INDUSTRIAL MQTT NETWORKS AT SCALE WITH EDGE COMPUTING



The second of a two-part article explaining the fundamentals of the MQTT protocol, and how it can be adapted to industrial applications.

In Part 1 of this article, the general operation of the MQTT protocol was introduced and its features and benefits described. Because the default specification of MQTT lacks features necessary for practical application in an industrial IoT environment, the Sparkplug MQTT Topic Namespace and Payload Definition was introduced. In Part 2 we continue with more explanation of Sparkplug B, and how MQTT with Sparkplug B can be practically implemented.

Sparkplug B features

Topic namespace

Sparkplug B (SpB) defines a standard format for MQTT topic paths, creating a unified namespace for all SpB clients on the network:

spBv1.0/⟨Group ID⟩/⟨MESSAGE TYPE⟩/⟨Edge Node ID⟩/⟨Device ID⟩

The elements are defined in Table 1.

Payload definition

Sparkplug B defines a standard, structured, data-rich but efficient payload format.

The core payload contains a structured series of key-value pairs defining an array of metrics and associated metadata. The specification defines a variety of optional fields for each metric, such as name, description, datatype, checksum, historical data flag and many more.

Data type indicators accommodate complex types common in industrial applications, like matrices and user-defined types (UDTs). The payload specification also permits an array of custom properties for each metric, such as engineering units or scaling limits, that are published along with the primary process variable or data object.

Table 1: Sparkplug B topic namespace definition.

Element	Definition	Source
<Group ID>	A logical identifier for a group of MQTT nodes	Defined by user
<MESSAGE TYPE>	Indicates whether the message contains state information, data, or a command and whether it pertains to a node, device, or the primary application	Predefined by SpB spec; cannot be changed by user
<Edge Node ID>	Identifies a specific MQTT node	Defined by user. The Group ID/Edge Node ID combination must be unique
<Device ID>	Identifies a device attached physically or logically to a node	(Optional) Defined by user, if applicable

The full payload is then timestamped, sequenced and encoded using Google protocol buffers (protobufs), an efficient, interoperable, binary representation of the structured data, which maintains a small on-the-wire footprint without sacrificing complexity. When decoded, the payload is typically represented in JavaScript object notation (JSON) but is compatible with many formats.

State management

Sparkplug introduces the concept of birth and death certificate messages to define and ensure the use of appropriate state monitoring mechanisms.

The death certificate simply formalises the use of MQTT's last will and testament message. Triggered when a client's keep-alive timer has expired, the death certificate indicates an unexpected disconnection. The topic path follows the standard Sparkplug format, using the message types NDEATH and DDEATH, indicating that the certificate pertains to a node or to an attached device, respectively.

The birth certificate, on the other hand, is a new addition of the Sparkplug spec. It is a special message, utilising message types NBIRTH or DBIRTH, that a client is required to publish for itself and each of its attached devices when first coming online. These messages contain all the published topics for that client or device and inform all subscribers that the client or device is online.

Primary application

While an MQTT network may contain any number of application clients, an industrial setting often has a single critical application used for operations management or process control, like an IIoT or SCADA host. This application is typically the only one permitted to send commands into the network. The Sparkplug specification adapts the MQTT framework to this reality by allowing one application node to be designated as the primary application.

An SpB-compliant primary application — like Cirrus Link's MQTT Engine module for Ignition SCADA or Canary Labs's MQTT Data Collector — publishes special birth and death certificates using the topic STATE/⟨client ID⟩. Unlike regular death certificates, these messages are published with QoS 1 and are retained by the broker to ensure that any MQTT client can identify the primary application's state at any time.

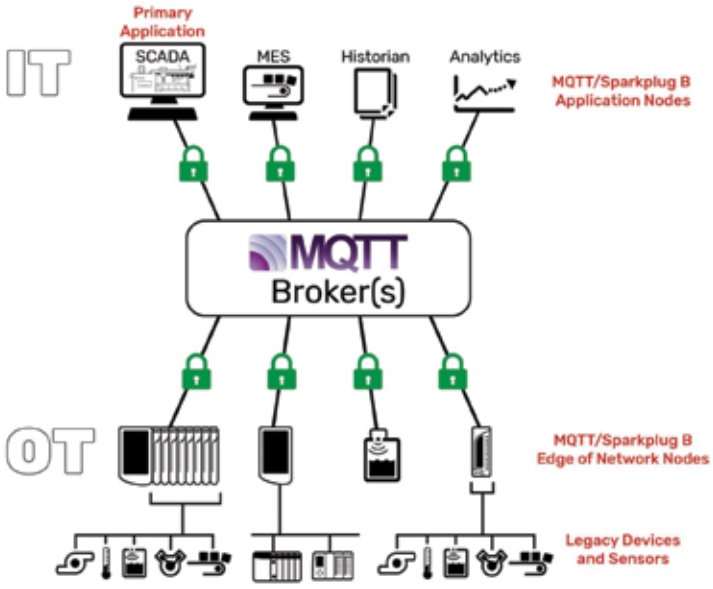


Figure 1: The MQTT/Sparkplug B architecture defines clear roles and behaviours for MQTT clients and their data, adapting the underlying MQTT framework to better support typical SCADA/IIoT use cases.

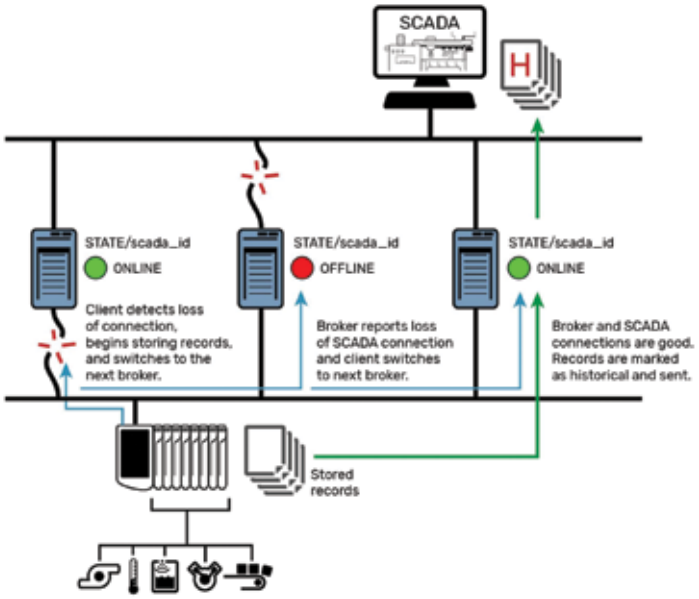


Figure 2: The primary application mechanism enables smart failover and historisation.

This mechanism enables two additional functions that are critical to building fault-tolerant industrial networks:

- **Enhanced failover:** If an MQTT client loses its current broker connection and other connections are available, it can switch automatically. In addition, a Sparkplug B-compatible client can also switch connections based on the value of the primary application's STATE topic. When the primary application's connection is interrupted, its death certificate is published by the broker, indicating that STATE has changed to OFFLINE. SpB clients will see this and begin searching through their alternate connections for a broker that reflects an ONLINE status for the application.
- **Store-and-forward historisation:** In combination with the flags built into the Sparkplug B payload, a client can indicate that a message contains historical, rather than real-time, data. If capable, a client can begin storing records any time it or the primary application disconnects, queuing them up until it is assured of safe delivery, then publishing them as historical records. Since these messages are distinguishable from real-time data, store-and-forward provides better continuity for time-series data and time-critical operations than MQTT's standard quality of service levels.

Advantages for industry

Interoperability

The Sparkplug B specification addresses the potential for inconsistency in MQTT implementations by defining standard client roles and data interfaces designed around industrial applications. By standardising on Sparkplug B, MQTT clients from different vendors can identify, interpret and make use of published data without needing to know the details of the originating client. Even brownfield sites with legacy automation networks and devices can leverage Sparkplug because of its explicit support for gateway-attached devices.

Unified namespace

This level of interoperability satisfies a critical requirement for digital transformation by making possible an enterprise-spanning unified namespace, a common data source defining all business data. Instead of hunting for operations data spread throughout a hierarchy of applications (PLC › SCADA › MES › ERP, for example), each with its own schema and data structures, MQTT devices and applications all contribute to a single data endpoint: the MQTT broker.

Enterprise clients can consume data from the field via the broker, using Sparkplug to provide a common exchange format and uniform context. Their results can be published back into the network to be detected, interpreted and acted on by other clients. In this way, data can be shared seamlessly throughout the organisation, eliminating data silos, reducing the potential for discrepancies and allowing a connected system to scale up smoothly.

Enhanced data integrity

Sparkplug also improves data integrity and consistency with its combination of reliability features. By enforcing the last will and testament mechanism, all subscribers are notified when pertinent data becomes stale, and the birth certificate lets them know when data is fresh again. And for applications like those in regulated industries that require historical data for auditing or root cause analysis, store-and-forward historisation provides protection against critical data loss in the face of network or client instability.

Low administration

The combination of Sparkplug's enhanced state management and interoperability unlocks an additional contributor to network scalability by reducing the administrative overhead required to integrate each node and device.

As mentioned, integrating traditional industrial data involves time-consuming tag/variable mapping between applications. But with Sparkplug's birth certificate mechanism, this process is sped up by orders of magnitude. Subscribers, the primary application in particular, can use the information published in the birth certificate to map out available topics in a matter of moments. Since a birth certificate is required from each cli-

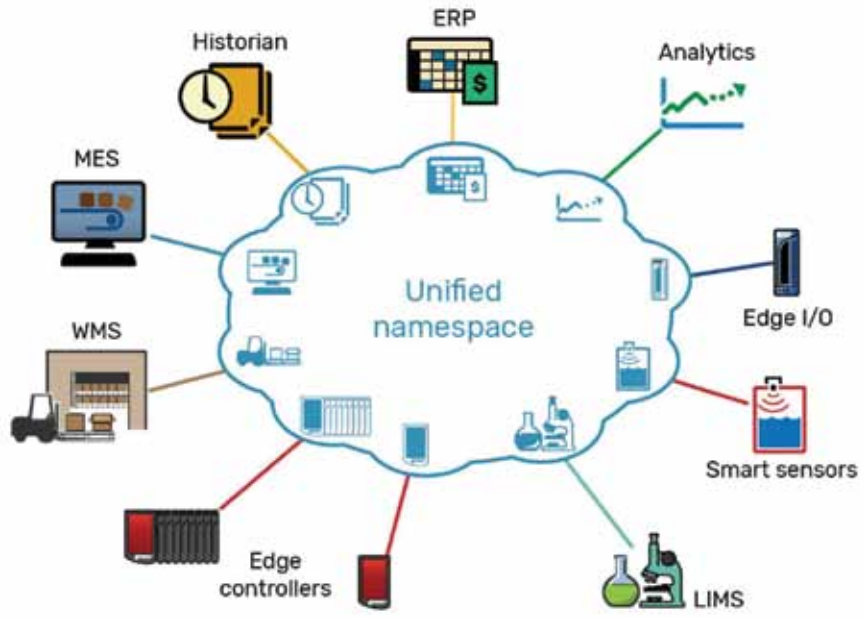


Figure 3: With Sparkplug, data from many domains can be shared interoperably across an organisation.

ent whenever it connects to the network or updates its topic structure, the tag hierarchy can be discovered automatically. And thanks to Sparkplug B's payload structure, it comes complete with all metadata and UDT definitions.

Building mission-critical MQTT networks

Sparkplug B fits MQTT to the needs of industrial applications by defining an open, interoperable standard for industrial data exchange that supports common use cases and the complex data they require, without compromising efficiency. By explicitly defining client roles and message types, Sparkplug B also enhances MQTT's ability to reliably deliver data to the right people at the right time, all of which can give users confidence as they scale up the network.

However, MQTT/Sparkplug B is of little value without robust support from all network clients. Specific features that Sparkplug provides, like legacy device integration and store-and-forward historisation, can't be fully realised without field device clients that implement the necessary gateway and storage functions.

And fundamental network reliability is undermined unless every network participant implements complementary cybersecurity and connectivity features. Even the sheer volume of data generated by a large Sparkplug B IIoT network can be overwhelming unless clients are able to filter and sanitise data locally before publishing. Unfortunately, traditional industrial devices were designed with a narrow scope of operation in mind and lack much in the way of general-purpose processing, communication and storage.

To address these general gaps in operations technology (OT), many industrial automation vendors are drawing inspiration from information technology (IT), turning to an approach known as edge computing — a form of distributed computing that addresses bandwidth constraints in global and regional networks by moving computing resources geographically closer to areas of high demand on the edge of the network.

Industrial edge computing

Industrial edge computing mimics this approach by embedding data processing, networking and storage at the local process level, rather than strictly in the network core. With more resources at the edge, data can be prepared locally before broad distribution, modern security measures can be layered onto legacy systems, and advanced functionality can be embedded in the process in support of a resilient network.

Industrial edge computing devices come in many varieties, including edge I/O modules and edge programmable industrial controllers.

- Many edge I/O modules can scale horizontally, integrating a variety of traditional field signals (V, mA, ICTD, TC, thermistor, discrete I/O, dry contacts, and so on) and making their data available directly to Ethernet networks.
- Edge controllers offer more computing and networking power alongside a traditional PLC/PAC control engine, providing a broader array of integration options and allowing disparate automation networks to be combined into a single system.

Using industrial edge devices like these in combination with appropriate server hardware, users can build up a secure MQTT/Sparkplug B network following a basic pattern:

First, instrument assets if needed, and connect the I/O to an edge device.

If existing controls are in place already, they can be connected to a segmented network interface on the edge controller, which can use OPC UA drivers to pull the data in.

Then, the edge controller can open an encrypted, authenticated connection to an MQTT broker, residing either in the cloud or somewhere on premises, ideally in the corporate network's DMZ.

Now, applications can be plugged into the infrastructure. A gateway application with a Cirrus Link MQTT Engine, can subscribe to the entire system's tags and make all that data available to other applications, including back into OPC, if needed.

With this foundation, the system can scale up with additional edge devices or additional brokers to build out a highly resilient, high-performance data exchange and command-and-control system that's completely secure.

Conclusion

MQTT is popular, proven and well supported in enterprise and consumer applications. It makes organisation-spanning data exchange possible by decoupling data producers and consumers using a brokered publish-subscribe architecture and by defining a lightweight, data-agnostic communication format that supports millions of connections.

Sparkplug B defines an MQTT implementation standard that ensures client interoperability and enhances MQTT with features designed to support the demands of mission-critical industrial systems. The resulting infrastructure delivers data that is fit for use in operations, gracefully handles instability and helps organisations scale by reducing administrative overhead.

Industrial edge devices complete the architecture by providing complementary reliability in the physical layer, along with a variety of integration options and sufficient computing power to process and transmit field data efficiently and securely.

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NEW PRODUCTS

EDGE AI SYSTEMS

The AIR-020 series of ultra-compact, edge AI systems are powered by the NVIDIA Jetson family. They deliver low power computing with powerful AI inferencing capabilities using NVIDIA Jetson Nano, TX2 NX and Xavier NX SoM.

The AIR-020X supports up to 21 TOPS (tera operations per second) and 1058 FPS (frames per second), targeting high-resolution imaging processes. Meanwhile, the AIR-020T and AIR-020N support 1.33/0.5 TFLOPS and up to 109/48 FPS. The entire AIR-020 series supports wide-range 12–24 VDC input, a -10 to +55°C operating temperature and vibration and humidity resistance.

The AIR-020 series is also equipped with a range of I/O ports including two USB 3.2 Type A, USB 3.2 Type C, one or two GbE ports, one or two RS-232/422/485 serial ports, 8-bit DIO, and CANBus for data acquisition and communication. These compact AI boxes are pre-installed with 4 GB or 8 GB LPDDR4 RAM and 16 GB eMMC 5.1. The AIR-020 series also provides 128 GB of M.2 storage as the data storage default for AI usage.

The AIR-020 series is bundled with the Ubuntu 18.04 LTS operating system, Advantech Edge AI Suite and JetPack SDK 4.5.1. For data security, the series adopts the TPM 2.0 trusted platform module and secure boot, which allows for compute-intensive industrial applications and better system security on the edge. This series is suitable for edge AI applications such as traffic monitoring, defect inspection, AGV/AMR, people counting and medical imaging.

Advantech Australia Pty Ltd
www.advantech.net.au

LONG RANGE LASER DISPLACEMENT SENSOR

The Micro-Epsilon optoNCDT ILR2250 Long Range Laser Displacement Sensor offers a high-resolution measuring capability of 0.1 mm for medium- to long-distance measurement. This industrial laser distance sensor operates based on the phase-comparison principle and can measure over distances of up to 100 m, which can be extended to 150 m by attaching an additional reflector film on the object to be measured.

This laser distance sensor is a bridge between the traditional long range laser and laser triangulation sensors. It also comes with an auto-integrated measurement mode that offers high signal stability. This new measuring mode allows the sensor to measure where there are challenging surfaces such as dark, structured or weakly reflecting surfaces.

The ILR2250 features a robust, industrial design with an IP65 certified die-cast aluminium housing for protection against dirt and splashes of water. The ILR2250 is also integrated with a mounting plate with four threaded pins for easy mounting and aligning of the laser. Offering stable measurement it can be easily integrated in any measurement system, such as for high-volume OEM manufacturing.

Due to its compact size and lightweight structure, the optoNCDT ILR2250 is designed to be easily implemented in plant automation systems. It has also been used in many other applications such as position measurement on gantry cranes, filling level measurement in silos, coil diameter measurement and drone integration for aerial distance measurement.

Bestech Australia Pty Ltd
www.bestech.com.au

SERIAL TO ETHERNET CONVERTER

Weidmüller has released a secure and easy-to-use serial to Ethernet converter and Modbus gateway, the IE-CS-MBGW-2TX-1COM. The device offers a 1-port RS-232/422/485 to 2-port Ethernet device server with a Modbus protocol gateway, allowing easy transfer of serial and Modbus data to Ethernet and vice versa.

Device configuration is performed through a secure web interface supporting HTTPS, SSH and SSL encryption to establish the security of data, coupled with an intuitive interface allowing for quick set-up of its Modbus gateway mode. It supports the operation modes of virtual com, serial tunnel, TCP Server, TCP Client, UDP and a desktop-based utility allows for the configuration of multiple devices mapped to virtual com ports.

The device features a dual redundant power supply input from 12–48 VDC, a wide operating temperature of -40 to 70°C and a rugged IP30 housing, making it suitable for operation in harsh and demanding industrial environments.

Weidmuller Pty Ltd
www.weidmuller.com.au

Manufacturing COVID-19 rapid diagnostic tests

The COVID-19 pandemic has rapidly spread to all parts of the globe. There have been more than 500 million cases around the world and this figure continues to rise rapidly. Healthcare systems are overwhelmed and continue to face a multitude of challenges as they work to manage demand while providing high-quality care.

Communities, governments and industry around the world are now recognising the importance of minimising the requirement for widespread lockdowns and travel restrictions, which have been the main line of defence against COVID-19 since the start of the pandemic.

As countries around the world move towards a new post-pandemic normal, rapid diagnostic testing has an integral role in reducing disease burden, managing outbreaks and community transmission, and reducing pressure on healthcare systems.

Ellume, a Brisbane-based digital diagnostic company, has recently developed a rapid COVID-19 home test which detects the SARS-CoV-2 antigen and complies with Centers for Disease Control and Prevention (CDC) reporting requirements. Accurate results are provided within 15 minutes, providing users with quick results. With a growing list of orders, predominantly from the United States, ensuring supply was a key priority for Ellume.

To meet the consumer demand for COVID-19 home tests, Ellume has invested in new manufacturing lines for its facilities in both Australia and the US.

"COVID-19 isn't going away anytime soon and as communities and economies continue to open up there will be increased need for rapid antigen tests, which is why automating our production is vital to meet a surge in consumer demand," said Dr Sean Parsons, founder and CEO, Ellume.

Ellume called on Bosch Australia Manufacturing Solutions (BAMS) to automate the high-volume production of its COVID-19 diagnostic tests. This involves 27 new production lines in total — three new lines for Ellume's facility in Brisbane and 24 production lines for its facility in Maryland.

"We are providing Ellume with 18 fully automated assembly lines for manufacturing the home COVID-19 analyser unit. This also includes an end-of-line test system that communicates to the analyser unit over Bluetooth and completes a functional check to ensure the quality of the part," said Bradley Trewin, Programme Manager, BAMS.

"BAMS is also manufacturing nine lines for the production of the 'dropper' which will fully automate the assembly and packing of this product," he added.

The production lines are being manufactured at Bosch's headquarters in Clayton, Victoria. More than 160 robots are being utilised on this project; there are also more than 200 vision systems — cameras that inspect and evaluate the line — and more than 60 PLCs.

"We are delighted to bring the BAMS automation expertise to support Australian medtech manufacturing for a global market — a real positive for local manufacturing, and a positive for the testing and medical diagnosis of COVID-19," said Gavin Smith, President of Bosch Australia.

Ellume's technology addresses the unprecedented global demand for accurate and rapid diagnostics as accessible, reliable and fast diagnostics become increasingly critical to the COVID-19 response.

Given the widespread supply shortages resulting from the pandemic, Rockwell Automation has prioritised its global supply chain to applications and machines that can help in the fight against COVID-19. "Our priority is to support local manufacturing, helping to ensure that we are able to provide much-needed assistance to those requiring it urgently," said Anthony Wong, Regional Director, Rockwell Automation. "By working with local innovative companies such as BAMS and Ellume, we can deliver next-generation technologies to help mitigate the risks of COVID-19 while also strengthening the Australian manufacturing industry."

The new Ellume manufacturing facility will be one of the largest of its kind in the Southern Hemisphere. The production lines for Ellume's Brisbane facility are now operational, while the final lines for the US are expected to be installed and operational in mid-2022. Once complete, the production capacity across the whole Ellume project will be nine parts per second.

"We've spent the last decade perfecting our technology, and now, in the midst of the COVID-19 pandemic, the role of rapid, accurate diagnostics has never been more important. Ellume is pleased to be working with Bosch to bring their world-leading automation know-how to our manufacturing process. This will allow Ellume to manufacture best-in-class diagnostics that can be relied on in a health crisis," said Parsons.

Rockwell Automation Australia
www.rockwellautomation.com/en-au.html

IS TABLET

The Pepperl+Fuchs ecom 8″ Android tablet Tab-Ex 03 DZ2/D2 comes in a slim and lightweight design, and is designed for use in Zone 2/22 and Div. 2. The multi-touch display can be operated with an S Pen and with gloves, and offers optimal readability even in direct light. From indoor pharmaceutical applications to harsh ambient conditions, the Tab-Ex 03 is designed for use in temperatures ranging from –20 to +55°C.

Based on Samsung's Galaxy Tab Active3, the device is designed to offer high data and device security via the Google Android operating system and Samsung Knox. The Tab-Ex 03 supports all Knox features like mobile enrolment, configuration management and E-FOTA. Besides biometric authentication and a baseline protection against malware, the basic device, Samsung Galaxy Tab Active3, is part of the Android Enterprise Recommended (AER) program.

Via Samsung DeX mode, the Tab-Ex 03 can be quickly and easily connected to a keyboard, mouse and monitor in the office, providing a full desktop experience and offering with its one-device-strategy a cost-saving alternative to desktop PCs. Charging and data transfer take place via a pogo pin connector. Special keys on the Tab-Ex 03 can be customised — eg, as an emergency key for maximising safety. Google ARCore is used to implement augmented reality applications, such as remote support and training, and tailor-made tools for predictive maintenance.

Pepperl+Fuchs (Aust) Pty Ltd
www.pepperl-fuchs.com

INDUSTRIAL-GRADE PC

The EPC-R7200 industrial-grade PC is designed for AI developers that use NVIDIA Jetson family modules, including Jetson Xavier NX, Jetson TX2 NX and Jetson Nano. It is designed for the prototyping and mass deployment of edge AI applications in diverse industries.

Edge AI applications, including image inference, require premium camera inputs. Accordingly, the EPC-R7200 provides two 2-lane MIPI-CSI2 camera inputs for intelligent vision-based systems. It also features an HDMI 2.0 port for 4K resolution displays, two GbE LAN ports for connectivity, two USB 3.2 Gen 1 ports and two M.2 slots for wireless modules (a 2230 Key E and a 3042 Key B).

Featuring a high-quality aluminium housing, the EPC-R7200 offers improved heat dissipation and ESD protection. The EPC-R7200's thermal design also accommodates modular and module-specific heat spreaders, enabling developers to adopt thermal solutions based on the Jetson module they apply.

The EPC-R7200 is compatible with the NVIDIA SDK and enables AI developers to transfer Jetson modules from the kit to the barebones PC. Users can also automatically actuate I/Os without further driver installation or function configuration setup, reducing the development time and resources required for system integration and verification. The EPC-R7200 supports wide operating temperatures, high power input and has a high vibration tolerance.

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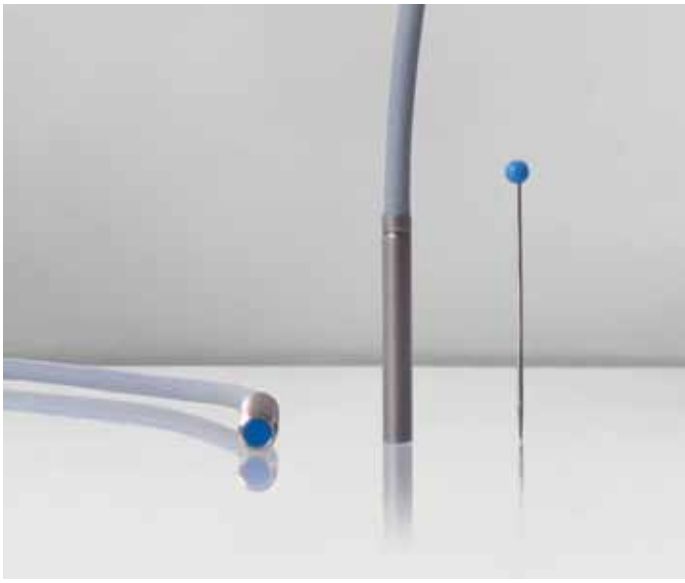
www.advantech.net.au

COMPACT INDUCTIVE SENSORS



The Wenglor I03 series inductive sensors have a diameter of just 3 mm (D3) and a smooth housing, while the I04 series has an external thread with a total diameter of 4 mm (M4). With both series, the housing is 22 mm long. The almost invisible miniature sensors are said to detect precise switching signals in places where virtually no installation space is available. They also offer increased switching distances of up to 1 mm, a robust PUR cable connection (two metres), a high IP67 degree of protection and a broad operating temperature range of -25 to +70°C.

Optional PNP/NPN and NO/NC variants also enable convenient integration with existing systems. A LED adjustment aid shows the sensor status clearly over long distances.

Due to their small size and low weight, the inductive sensors are suitable for end position detection of gripper systems in the production of wires and cables, for example. In addition, they can also be flush-mounted in robot grippers in the automotive industry for detecting the gripper opening and closing. The small sensors also offer support in the wood industry in pallet nailing machines. The continuous supply of nail pins can be monitored directly in the dispenser unit. The monitoring of drive shafts in chain conveyor systems in the packaging industry is also a potential application of these sensors.

Treotham Automation Pty Ltd

www.treotham.com.au

A GUIDE TO COLLABORATIVE ROBOT SAFETY

Strategies for ensuring safe operation in collaborative applications.

The ability of collaborative robots to share tasks with humans and flexibly adapt to new requirements can provide high returns on investment in a wide variety of industrial applications. Manufacturers employ these robots to reap the benefits of integrated safety features that allow them to work with or close by humans and boost productivity for a wide variety of repetitive tasks.

Despite the numerous safety features that include lightweight frames, collision detection technology and minimised pinch points, appropriate safety measures must still be considered for the overall application — including the gripper, end effector and other equipment located near the collaborative workspace. Safe implementation based on comprehensive risk assessments is crucial for ensuring the success of a collaborative robotic application.

This article discusses industry standards, project stages and solutions for getting the greatest value from collaborative robots

(commonly known as cobots). It also defines and discusses safety requirements for the robots themselves as well as the collaborative workspace and typical collaborative operations.

What are collaborative robots, and what safety standards apply to them?

Collaborative robots are designed to work with human operators thanks to technologies like force feedback, low-inertia servomotors, elastic actuators and collision detection technology that limit their power and force capabilities to levels suitable for contact. More compact than conventional robots, cobots generally have lightweight frames with soft, rounded edges and minimised pinch points.

Force and speed monitoring are the defining abilities of collaborative robots. When they are equipped with safety devices that detect when a person has entered the collaborative workspace, they are often allowed to operate at higher speeds. This helps them maximise throughput when people are not present within the hazard zone.

The safety standard ISO 10218 and technical specification RIA TS 15066 define the safety functions and performance of the collaborative robot. Under TS 15066, the force and speed monitoring of the cobot is set based on application data, human contact area and workspace hazards. Human contact is defined in two types: transient and quasi-static. The former refers to contact that is non-clamping, whereas the latter involves situations that can cause a body part to be clamped.

Application data, possible human contact and workspace hazards all factor into the calculated safety settings based on TS 15066. This may be a challenging task for manufacturers who are not familiar with safety standards, in which case they can hire a safety assessment provider to make the calculations and offer suggestions for improving the safety of the overall collaborative application.

How does hand-guided teaching work, and what are the important safety considerations?

ISO 10218 and ISO/TS 15066 provide standards and guidance for collaborative robot teaching functionality. Many collaborative robots employ intuitive hand guiding mechanisms for teaching new tasks without the need to explicitly program the movements of the robotic arm. Hand guiding mode monitors force and speed to ensure that the teaching process complies with safety standards.

The safety of hand-guided teaching meet safety standards in the following manner.

1. Enabling hand guiding

Before an operator enters the robot's workspace for teaching, the robot must be stopped even if its force and speed limiting functionality is activated. Otherwise, a protective stop must be executed upon detection of the operator by a safety device like an area scanner.

Unlike with high-speed robots, the operator can activate the teaching mode using a simple trigger, button or mode selection as long as safety force and speed monitoring are active. Otherwise, a three-position safety enable is required.

Safety standards require the teaching mode transition to be deliberate, to not lead to unexpected motion and to avoid creating additional hazards.

2. Ensuring safe teaching

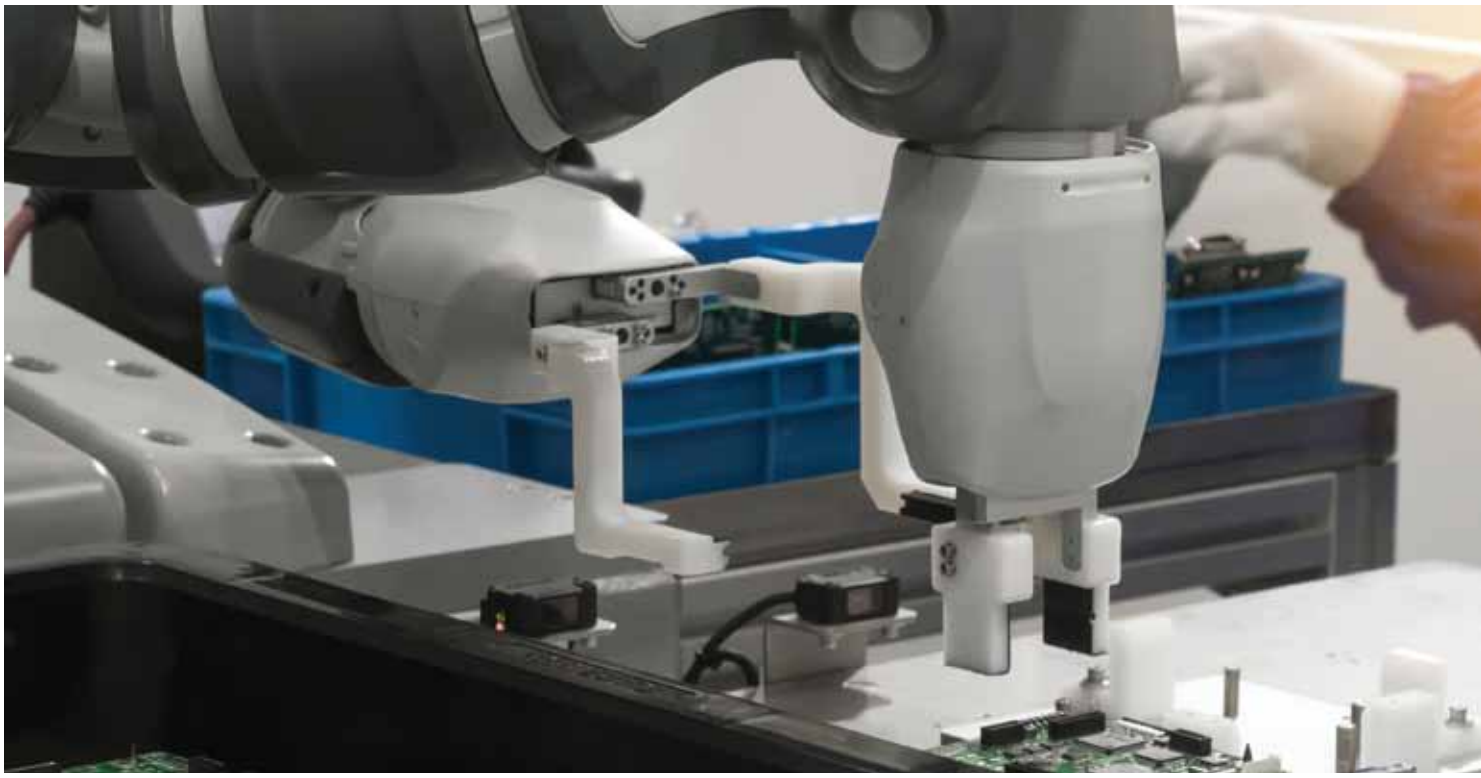
As the operator is responsible for the robot's motion, they must be aware of surrounding equipment and safety concerns at all times.

It is possible to enforce limits in motion, such as space and soft axis limits, to help keep the operator safe.

3. Enabling safe operation

The operator must first vacate the safeguarded space. This can be detected by safety sensors or additional operator verification.

To re-enable the robot for operation, intentional mode selection must be provided.



What is the collaborative workspace, and what are the important safety considerations?

Collaborative robots perform automated tasks around other equipment that could potentially cause harm. The area in which a collaborative robot operates, including any tooling or additional equipment, is known as the collaborative workspace. As defined by the ISO 10218 or ANSI RIA 15.06, this is the space within the safeguarded area where the robot and human can perform tasks simultaneously during production operations. Similarly, TS 15066 defines it as the area within the operating space where the robot system can perform tasks concurrently with a human operator during production.

It is important to list and map out all additional equipment in the complete collaborative automation project. Manufacturers should be sure to evaluate each device for potential hazards and safety sensors to prevent human and equipment damage. In addition, the collaborative workspace must be clearly marked.

The following are examples of non-collaborative safety-rated equipment that can be part of the workspace requiring safety devices:

- Material handling
- Tooling
- Grippers and actuators
- Machines

Safety devices are generally quite easy to integrate into a collaborative robotic application. The following are a few solutions for safeguarding the collaborative workspace.

1. Open area safety guarding solutions

Safety area scanners and mats are the most popular safe guarding for collaborative robots. They are also some of the simplest items to integrate into applications with low hazards and few additional pieces of equipment.

2. Gated/limited area safety guarding solutions

Safety light curtains and safety switches are used for applications with hazards or high-speed operation enablement for increased productivity.

3. Active hazards safety guarding solutions

When a hazard is present, or operation could cause a hazard, operators can enable the 'deadman' switch — a switch that automatically goes back to the "off" position if the user fails to exert pressure — to provide safeguarding.

Maximising safety in collaborative operations

It is essential for manufacturers to validate their collaborative robot applications for safety across all operations. Every application is unique, but there are some guidelines manufacturers can follow when evaluating the safety of a robot while performing a given task in collaboration with a human operator. Drive and power hazards may still exist even if the robot is not moving.

1. Safe robot enable

Whether starting up the robot or recovering from an emergency stop, there must an intentional act to enable the robot that ensures operators are safe and no hazards are present. For example, when an e-stop is activated by an operator, the robot should not perform an automatic re-enable. Instead, it should require input from a second operator verification action.

2. Safe hand guiding

During design and safety set-up, manufacturers must ensure that hand guiding can only occur after (1) the robot has stopped, (2) intentional mode selection has occurred and (3) speed and force monitoring are active. For example, if the hand guiding activation occurs without a stop command or safety input, this should initiate a safety stop and fault.

3. Safe operation

Enabling the automatic or run operation of the collaborative robot must be an international mode selection by the operator that requires all safety devices and conditions to be validated for operation. For example, operators must be protected from hazards on the end of tooling before enabling operation.

4. Safety validation

It is important for manufacturers to have a safety assessment service group review all the surrounding areas and equipment and to have a safety remediation service performed if necessary. Safety service groups will perform an onsite inspection to assess the safety of equipment, confirm certifications, verify safety parameter settings and document that safety validation has been completed.

Safety considerations for collaborative machine tending applications

Machine tending is the most common application for collaborative robots due to the ease of installation, the high return on invest-

ment and the benefits from the robots' flexible manufacturing capabilities. Machine tending applications can be misleading in their appearance of safety — in fact, they are one of the industry's top safety concerns for experts who have completed many inspections and safety assessments.

To maximise safety in automated machine tending applications, manufacturers should be sure to use a safety-rated gripper to safeguard against operator injury, and they should also investigate whether the product itself presents any dangers (such as extreme heat or sharp edges).

Other things to consider include:

- Do other machines need to be safety control-linked to prevent either from operating when the other is in a safety stop condition?
- Is material handling equipment being used? If so, what are the necessary safety considerations?
- Since collaborative robots used in machine tending can be moved from machine to machine, how is the safety setting and program validated?
- Are there warning zones for the operator that will indicate hazards or operation interference?

It is also extremely important to review the entire area for any circumstances where an operator could be trapped or clamped by the robot and surrounding pieces of equipment.

Safety considerations for collaborative material handling applications

Material handling applications that benefit from the incorporation of collaborative robots encompass picking, packing, palletising, sorting and more. The wide-ranging use of these applications makes them a more site-specific solution for safety implementation. Operators and other workers are often moving or transporting other materials around the collaborative robot, requiring additional planning to avoid hazardous contact.

Safety-rated grippers are rare in the market at the present time. Currently, manufacturers typically use pneumatic grippers, which require safety considerations for impacts and the loss of power or suction. Application designers must also investigate whether the product itself presents any dangers like being heavy or containing hazardous material — characteristics that could be especially problematic if the product were to be dropped.

Other things to consider include:

- Do other machines need to be safety control-linked to prevent either from operating when the other is in a safety stop condition?
- Since collaborative robots can be moved from application to application, how could this affect validation of the safety settings and program?
- Are there warning zones for the operator that will indicate hazards or operation interference?

As with automated machine tending applications, manufacturers must review the entire area for any circumstances where an operator can be trapped or clamped.

Safety considerations for collaborative assembly applications

Assembly applications employing collaborative robots often involve special tooling and close collaboration with operators while also requiring high-speed operation zones to be present.

The extensive variety of custom end-of-arm tooling makes these applications especially complex. If multiple robots are involved, application designers must carefully coordinate the safety solutions for each one.

As with material handling applications, it is important to consider safety requirements for pneumatic grippers, places where an operator could be trapped or clamped and any products that are heavy or that contain hazardous substances.

Other things to consider include:

- Do other machines need to be safety control-linked to prevent either from operating when the other is in a safety stop condition?
- Since collaborative robots can be moved from application to application, how could this affect validation of the safety settings and program?
- Are there warning zones for the operator that will indicate hazards or operation interference?

Summary

Designed with a human collaborator in mind, cobots are generally considered to be safe. Nonetheless, they still require risk assessments to guarantee the safety of human operators throughout their use. It is crucial for manufacturers to consider all the possible hazards associated with hand-guided teaching, including transient and quasi-static contact, as well as what may happen when the robot is involved in an emergency stop.

Designers of automated machine tooling, material handling and assembly applications must consider all the ways in which the robot would interact with an operator, what aspects of the surroundings might cause clamping or entrapment and what characteristics of the end-of-arm tooling might pose a risk due to high heat, sharp edges or other hazards. If a risk assessment is performed thoroughly and requisite safety measures are implemented, it will ensure the successful efficiency gains of an application and boost performance.

Reference

1. Omron 2019, *Get to Know Collaborative Robots Series*, ‹‹https://automation.omron.com/en/us/solutions/success-stories/get-to-know-collaborative-robots-series››

Omron Electronics Pty Ltd
www.omron.com.au

ELECTRICAL PRESSURE CALIBRATION PUMP

Beamex ePG is an electrical pressure pump for industrial pressure calibration applications. It is a robust, portable battery-operated pressure pump that is said to enable easy and quick pressure generation from near vacuum up to 20 bar (300 psi). With a field-replaceable, long-lasting battery pack, users can perform a large number of pressure calibrations on a single charge.

The Beamex ePG can be used together with any existing pressure calibrator, meaning users do not need to buy a new calibrator but can simply replace their manual hand pump with the ePG. It is intuitive to use, with coarse and fine adjustment buttons to easily generate the required pressure. The Beamex ePG can also be serviced by the user to simplify maintenance.

When the Beamex ePG is used together with the Beamex MC6 family of calibrators, it enables fully automatic pressure calibration where the MC6 calibrator automatically controls the ePG. This optional feature will be available in the near future with a firmware update to the Beamex ePG.

AMS Instrumentation & Calibration Pty Ltd
www.ams-ic.com.au

COLLABORATIVE ROBOT

ABB is expanding its collaborative robot range with the introduction of the 6-axis GoFa CRB (Collaborative RoBot) 15000, to support the growing demand for a collaborative robot capable of handling heavier payloads to enhance productivity and flexibility.

Designed to safely work directly and continuously alongside humans and to be easy to install and use, GoFa is intended to help businesses automate processes involving heavier loads and longer reaches to assist workers with repetitive and ergonomically challenging tasks.

With a reach of 950 mm, and offering speeds up to 2.2 m/s, GoFa is said to offer an effective solution for a variety of applications, including materials handling, machine tending, component assembly, packaging and inspection, as well as laboratory automation.

GoFa features intelligent torque and position sensors in each of its six joints to offer higher power and force limiting performance. These joints eliminate the risk of injury to human workers by sensing any unexpected contact between the cobot's arm and a human to bring the robot arm to a stop within milliseconds.

Users can program GoFa via lead-through programming and ABB's Wizard easy programming software. Based on simple graphical blocks, Wizard is designed to make it easy for non-specialists to automate their applications. The blocks represent actions such as 'move to location', 'pick up an object' and 'repeat task', making it easy and intuitive to build a series of simple processes for the robot to perform.

ABB Australia Pty Ltd
www.abbaustralia.com.au

ETHERNET SWITCHES

Belden has announced the availability of its Hirschmann GREYHOUND 105/106 Ethernet switches that offer a high port density with support for multiple Gigabit speeds. The compact design combines hardened industrial hardware and high-performance switching and routing capabilities.

Users can choose the features best suited for their environments. Available in four main versions, GREYHOUND 105 and GREYHOUND 106, the switches can serve as an aggregation layer or backbone switch depending on the network's size.

Offering wide operating temperature ranges and with a fanless design, GREYHOUND 105/106 Ethernet Switches can be installed in both harsh environmental conditions and control cabinets without the need for cooling systems. Belden says the devices support networks in any industrial setting — including all segments of discrete and process manufacturing, energy production and transportation.

Control Logic Pty Ltd
www.controllogic.com.au

OPINION

OVERCOMING CHALLENGES TO REALISING PREDICTIVE MAINTENANCE FOR INDUSTRY 4.0

Predictive maintenance offers the ability to anticipate equipment malfunctions before they occur, arrange repairs proactively, avoid stalling factory floor operations and most importantly, prevent the failure of machinery to keep businesses running efficiently. Figures from Deloitte show predictive maintenance can reduce the costs of maintenance by 5 to 10% overall.

However, very few businesses have actually implemented predictive maintenance so far, as the process of doing so with existing equipment isn't without its difficulties. There are four major challenges engineers must overcome in order to work with data scientists and realise predictive maintenance capabilities amid Industry 4.0.

1. Cultivating a collaborative environment

To make the most of the benefits of predictive maintenance, it is necessary to create a collaborative environment in which domain experts in engineering and data scientists work together. If predictive maintenance is approached with a singular data analytics mindset, not all of the insights from the engineering teams that built the equipment and maintain it on an ongoing basis will be captured, and vice versa.

Powerful algorithms based on statistical methods that integrate the expertise and domain knowledge of engineers as well as data scientists are needed to ensure the key elements of each effective application are fully leveraged. With the right approach, it is possible for engineers to work together with data scientists effectively and realise the best predictive maintenance applications they can.

2. Training algorithms with not enough failure data

An important challenge for engineers implementing predictive maintenance to solve is how to train algorithms properly with failure data. Often engineering teams are easily able to include 'success' data from everyday production, but if the aim is to avoid it malfunctioning in the first place though, how can teams obtain failure data to train the algorithms?

The answer lies in simulation models, which can be used to produce artificial failure data. This data is irrespective of use cases and can range from wind turbines to air compressors. Using simulation to create failure data is a more efficient way to train AI than relying on the results of the factory floor which may not provide enough, or any, insight into failed mechanics at all.

3. Implementing algorithms in the real world

Once the algorithms have been fully trained on the desktop, the next challenge is deploying them into the industrial system equipment. How easy or difficult this task is depends on the condition of the existing IT and OT infrastructure. Some algorithms are applied onto real-time hardware platforms such as industrial PCs, embedded controllers or PLCs, while others are in the cloud or merged with current non-real-time infrastructure, for example an edge device running on Linux.

More and more, organisations are using toolchains to implement predictive maintenance in the real-world efficiently. These toolchains facilitate automatic generation of code, components or standalone executables.

4. Creating a business case for predictive maintenance based on data evidence

All the aforementioned challenges have available solutions, leaving one key problem — how to build a business case for predictive maintenance in the first place. Senior management will need to understand the return on investment that would be achieved before approving it, so detailing a comprehensive, data-driven plan is imperative.

To do this, engineers must develop an approach for how they will monetise predictive maintenance and calculate estimates on savings, such as on the reduction in equipment failure during operation.

Predictive maintenance is a vital part of engineering and manufacturing in Industry 4.0. By combining data science with engineering domain expertise, using simulation to create failure data, toolchains to deploy algorithms and a variety of techniques to build a solid business case, more engineers can implement this vital technology and start realising its value.

From reducing equipment downtime, to generating significant cost-savings, to boosting efficiency throughout the production line, the benefits of investing in predictive maintenance are too great to ignore.

**As industry manager for the industrial automation and machinery field at MathWorks, Philipp Wallner is responsible for driving the business development of this industry segment that comprises energy production, automation components and production machines. Prior to joining MathWorks, Philipp worked in the machine builder industry, where he held different engineering and management positions.*

NEW PRODUCTS

IO-LINK MASTER AND I/O MODULES

Due to a new type of housing with a washdown design, Balluff's BNI IO-Link master and I/O modules are suitable wherever regular cleaning cycles, among other things, occur in challenging environments.

The network devices are part of Balluff's Smart Automation and Monitoring System (SAMS). In addition to process and status data, these intelligent components are designed to provide diagnostic data, opening up possibilities to monitor the condition of machines and plants and take predictive/preventive maintenance measures.

The BNI IO-Link master is equipped with M12 L-coded power supply connections supporting a total current for sensors and actuators of up to 16 A. It also offers a REST API as a programming interface, so that data can be transmitted to the IT level in a number of ways.

Its optimised web server allows users to easily monitor status information such as operating hours or current and power. In addition, it offers functions such as user management and output tests.

The BNI IO-Link I/O modules offer variants for digital I/Os and for analog input signals. Depending on the application, users can manage up to 16 digital inputs and outputs (with or without separate power supply for high load) or up to eight analog signals. In addition, they offer module status values, such as an operating hours counter and vibration monitoring.

Balluff Pty Ltd
www.balluff.com.au

VIBRATION SENSORS

The Pepperl+Fuchs VIM3 vibration sensors are suitable for all standard applications using IO-Link or an analog interface. The large measuring range allows for vibration ranges up to 128 mm/s. Depending on the application, the housing is available in V2A, V4A or duplex steel with encapsulated electronics, with the aim of ensuring a long service life. The IO-Link version is also certified to SIL 1/PL c for use in safety-relevant applications.

VIM6 series sensors can measure data for both temperature and vibration speed and acceleration. Higher-than-normal temperatures may be the result of mechanical wear caused by friction and could result in machine damage. This measured value can therefore provide key information about machine condition. The VIM6 sensor is suitable for use in an extended temperature range from –40 to 125°C and has all the necessary approvals for worldwide use in hazardous areas.

The VIM8 series is suitable for applications in the mining or offshore sectors. Providing precise information about the machine condition, this series can measure the crest value of the vibration conditions to better classify bearing condition and potential wear in these applications. Rotary switches provide a convenient method for setting limits and delay times, allowing the device to be easily used without the need of an additional analyser or controller. Features such as an extended temperature range (–35 to 125°C), certifications to SIL 2/PL d and all the necessary approvals for global use in hazardous areas make this series a suitable choice for these more demanding applications.

Pepperl+Fuchs (Aust) Pty Ltd
www.pepperl-fuchs.com

MULTISTAGE CENTRIFUGAL PUMPS

GEA's Hilge CONTRA III multistage centrifugal pump is designed according to hygienic design guidelines, has electro-polished surfaces and high-quality sealing materials, and is suitable for use in dairy, beverage and food industries, in addition to pharmaceutical ones. Its increased drive power, over the smaller models, means its maximum flow rate is 100 m^3/h.

The pump's components are forged, deep-drawn and milled from 316L grade stainless steel and are designed to be hygienic and easy to maintain. Clean-in-place and sanitising cycle times can be reduced, leading to savings in water, cleaning agents and energy. Sterilisation-in-place pumps are also available, and the pump is able to remain in the pipeline for a motor change. Pipes are easy to clean, with a cavitation-free design, with a surface roughness from Ra ≤0.8 μm to Ra ≤0.4 μm.

A large number of configurations are viable, with both horizontal and vertical installations possible. For corrosive atmospheres, the product is available in the Adapta variant, which has EC conformity approval according to ATEX Directive 2014/34/E.

For plants that run on weekends or under partial loads, the speed control feature means water can be kept continuously in motion regardless of the operating phase, thus reducing the chance of contamination. The pump's frequency converters have a lower heat effect on the pumped media; less cooling is required therefore reducing energy and protecting the media.

GEA Australia
www.gea.com

STRAIN GAUGE AND LOAD CELL TRANSMITTER

Acromag's TT351 model is a space-saving 4-wire transmitter that converts a 4- or 6-wire strain gauge bridge or load cell or millivolt sensor signal to an isolated voltage or current output signal. An optional DIN rail bus can deliver primary or redundant power to multiple units.

Set-up and calibration is via USB connection to a PC and Acromag's Windows configuration software.

The transmitter's input circuit allows true 6-wire bridge measurement and includes an adjustable bridge excitation supply (4–11 VDC) with a remote sense feature. Sense wires ensure the programmed excitation voltage is measured at the sensor and enable lead-wire compensation. The differential input performs true ratiometric conversions for stable measurements that remain accurate over time and temperature.

Advanced signal processing capabilities, variable range input and convenient USB programming make this instrument very versatile for strain/load measurement. One model can process strain gauge, load cell and millivolt input signals from 1–10 mV/V. Initial bridge offsets or forces can be automatically removed with null compensation, tare and zero-balance bridge functions. An internal half-bridge can perform half- and quarter-bridge completion with precision resistor pairs or bias a floating millivolt input signal. A custom input signal linearised function supports up to 25 user-defined signal breakpoints. Flexible scaling is independently adjustable for input and output.

These transmitters can withstand harsh industrial environments and operate reliably across a wide temperature range with very low drift. They feature RFI, EMI, ESD, EFT and surge protection plus low radiated emissions.

Metromatics Pty Ltd

www.metromatics.com.au

FIVE WAYS PERFORMANCE INTELLIGENCE CAN TRANSFORM YOUR BUSINESS

Emon Zaman, Senior Vice President Asia Pacific, AVEVA

Performance Intelligence, the combination of data, analytics and human insight, will transform organisations, enhancing sustainability and resilience, driving efficiency, and revolutionising how employees work.

Ensuring continuity of operations in a rapidly changing world can be hard to achieve and even harder to maintain. Evolving supply chains, the need for sustainability and changing consumer habits continue to cause disruptions that can destabilise even the most robust business ecosystems.

This has spurred enterprises of all sizes to embrace digital transformation faster than ever before. AVEVA research has revealed that 85% of businesses plan to accelerate their investment in this area over the next five years, which will help them improve operational sustainability, agility and resilience by unlocking the performance benefits of automation, artificial intelligence (AI) and big data analytics.

Two thirds of organisations believe they're already on the journey to realising Performance Intelligence — how AVEVA defines the capacity to harness data-led insights so people can maximise sustainable value across assets, processes, locations and organisations — in order to realise key sustainability goals, become more agile, and empower teams by connecting their workforce with better collaboration tools and real-time shared data.

This article takes a look at just five of the ways Performance Intelligence can transform your business, helping it to evolve to meet both the challenges and opportunities of today and tomorrow.

1. Enhancing sustainability

Sustainability is at the forefront of industry leaders' minds, with nine out of ten industrial businesses committed to achieving net-zero carbon emissions within five years, according to a recent AVEVA survey. Performance Intelligence can help improve sustainability through the use of collaboration tools, real-time data and predictive analytics that provide greater visibility to track and optimise sustainability metrics.

Two thirds of organisations believe the ability to share data sets across teams in real time will have the greatest impact on sustainability, while significant sustainability gains can also come from solutions such as data monitoring and asset optimisation.

Take Neste for instance. The world's largest producer of renewable diesel and jet fuel is using optimisation to help it move closer to its target to become carbon neutral by 2035 by improving efficiencies and lowering waste.

"We need to use technology to transform every aspect of what we do so that we can operate more efficiently and drive sustainability throughout every aspect of our operations," said Salla Ahonen, Vice President, Sustainability at Neste.

2. Identifying problems before they occur

Organisations want their operations to run smoothly, and the best way to do that is to identify problems before they occur.

This is the power of Performance Intelligence. It enables predictive maintenance through improved data capture and analysis across the manufacturing process, helping staff improve maintenance schedules and lower costs while also cutting unplanned downtime.

3. Driving performance

The majority of companies understand that combining advanced technologies like the industrial internet of things (IIoT), cloud, AI, and machine learning (ML) with their teams' human insights is key to driving better performance across the organisation.

Connecting people, processes and assets empowers teams with real-time situational awareness that not only improves decision making and productivity, but also asset reliability and performance. In turn, improved performance offers key sustainability benefits through reductions in energy, waste and emissions.

Kellogg's Performance Intelligence system, for example, analysed energy usage and identified opportunities to lower it. This led to $3.3 million in annual savings, and an additional $1.8 million in rebates, in one plant alone.

4. Creating a connected workforce

It's no secret that data-led innovation is already transforming how workers perform critical jobs, with automation freeing them from simple, repetitive tasks to focus on those that require more creative thinking, people skills and fine judgement.

With one in three employees expected to continue working from home, digital workforce solutions are more important than ever before. However, a connected workforce is about much more than supporting our new hybrid way of working. Digital transformation and performance intelligence is as much about empowering people and shaping the skills of the future as it is about technology.

As part of a four-year strategic program, Veolia Water Technologies implemented a cloud-based, data-centric engineering platform to connect and empower its teams and unlock further efficiencies. The results included increased efficiency and collaboration between multi-discipline engineers and enhanced project transparency and status tracking, which in turn drove improvements in business agility.

"Cloud-based and data-centric engineering enables our teams all around the world to work remotely, yet together, on one platform that spans all of our engineering data," said Thomas Chelan, Projects Performance Director at Veolia Water Technologies. "It's fundamental for our staff to work in a collaborative way, in real time, all along the design and build phases. Efficient access to data is key to boost operational performance and achieve our strategic objectives."

5. Benefiting from data as a commodity

The amount of industrial data being collected by companies is roughly doubling every two years — this year alone it's estimated that 74 zettabytes of data will be created, captured, copied and consumed. With this in mind, it's easy to understand why data has become such a hugely important commodity.

Sharing accurate information across the business is shown to drive higher performance and sustainability, and is therefore key to competitiveness and profitability. But there are also benefits to sharing data more widely. A great example comes from Gwinnett County's Department of Water Resource. By making intelligent use of data from edge to cloud — including targeted data sharing with external organisations — it has been able to ensure the community has consistent, reliable access to water.

For example, by sharing data with the county's emergency operations control centre, the department is able to closely monitor and quickly respond to events such as extreme weather or natural disasters that could potentially cause a disruption to its service.

Transform your business with Performance Intelligence

Human insight, creativity and experience will continue to be essential to the success of every business, but when paired with the scope and scale of the cloud, the predictive capabilities of machine learning and AI and the connectiveness of IIoT, what you can achieve is elevated to a new level.

Performance Intelligence enables companies to optimise maintenance, minimise downtime, conserve energy usage and drive sustainable operations. Organisations that choose to accelerate their digital transformation will unlock the performance benefits of advanced technology to gain efficiencies and improve sustainability.

Isn't it time to see how your business could be transformed?

AVEVA

Aveva Software Australia Pty Ltd
www.aveva.com

BULK BAG DISCHARGING SYSTEM

Flexicon's BULK-OUT BFC bulk bag discharging system promotes the flow of bulk solid materials that have solidified during storage and shipment, automatically discharges the material and allows manual additions of ingredients from sacks, drums and other containers.

A cantilevered I-beam with electric hoist and trolley lowers a bag lifting frame to floor level for rapid attachment of the bag to patented Z-CLIP bag strap holders, and then hoists and rolls the bag into the safety frame, eliminating the need for a forklift.

The integral conditioner consists of two hydraulically actuated rams with specially contoured conditioning plates that press opposing sides of the bulk bag. A HMI housed in a NEMA 4 enclosure controls the stroke and number of ram actuations.

For bulk bag discharging, the bag outlet spout is pulled through an iris valve mounted atop a dust hood over the hopper. For manual dumping in conjunction with or independent of bulk bag discharging, the operator raises the hinged door and adds the material from smaller capacity containers through a coarse screen into the hopper. A fold-down support tray serves as a bag rest. The hopper can be configured to connect to pneumatic or mechanical conveyors, or directly to downstream process equipment.

The discharger can also be configured for weigh batch discharging with the addition of load cells and a programmable controller.

Flexicon Corporation (Aust) Pty Ltd

www.flexicon.com.au

CONTROLLERS

SIMATIC S7-1200 controllers feature a comprehensive range of technological functions and integrated communication as well as a compact and space-saving design.

The Siemens SIMATIC S7-1200 controller is designed as a compact CPU, which means that I/Os are already integrated. It can also be equipped with additional I/O modules to enlarge the capabilities of the PLC and make it suitable for a broader range of industry applications. Failsafe CPUs can also be selected when safety considerations must be met.

Because of these features, the S7-1200 offers flexible possibilities, including enhanced cross-platform data transfer with other controllers and higher-level or cloud-based systems. The applications are numerous, ranging from industrial use to agriculture and infrastructure projects.

The seamless integration of the SIMATIC controllers into the Siemens common engineering framework TIA Portal provides consistent data management, a smart library concept and a uniform operating philosophy. This makes it especially easy to use system-spanning functions.

Efficient error analysis and fast error localisation with Siemens' uniform display concept is designed to shorten commissioning times and minimise production downtime. SIMATIC S7-1200 offers diagnostic functionality already integrated in the system without additional programming work.

Secure communication, know-how protection, copy protection and access protection prevent manipulation, opening and duplication of blocks by unauthorised persons, thus protecting the algorithm or process.

APS Industrial

www.apsindustrial.com.au

VIRTUAL CAPABILITIES CHANGE PRACTICES

FOR PROCESSING OPERATIONS

Brian Van Valkenburg, Senior Manger Field Services and Training, Swagelok Company

Virtual site visits and training courses bring remote expertise to plants.

Connecting distant teams to solve local site issues at facilities has always presented logistical challenges. How can the team provide timely remote feedback? How soon can a full team of experts be onsite to address the issue? The same challenges have faced facilities as they collaborate with external suppliers providing services that have commonly required onsite visits.

As virtual technology has become more advanced, companies are starting to leverage these capabilities to allow their teams to connect from different locations more effectively. Whether companies need field engineering surveys or proper training for their personnel, virtual technology is allowing them to accomplish these goals with lower costs and fewer scheduling conflicts. Not surprisingly, virtual site visits and training programs are becoming essential tools in helping facilities run more efficiently and effectively.

Virtual field engineering visits

Before virtual technology became popular, field engineering visits to plants required a significant amount of time and expense. A group of field engineers would visit a site to evaluate various systems and equipment and provide multiple perspectives on their operation. Bringing multiple engineers to the facility not only resulted in significant travel expenses but also disruptions to the normal work of a facility.

During a virtual visit, only one field engineer is required to be onsite. Equipped with an augmented reality (AR) collaboration headset, that engineer can connect with other engineers around the world. This team of multiple engineers can then conduct a thorough evaluation of

During a virtual evaluation, the on-site engineer can share photos and videos with remote colleagues in real time so everyone can brainstorm solutions as a connected team.

equipment and areas of concern throughout the facility just as they would if they were onsite inspecting the applications personally. The use of AR headsets has proven to provide the same level of value to organisations as onsite visits — and sometimes even better, as world-class experts may be able to be present on a virtual visit when they wouldn't normally have been able to be at the facility for an in-person visit.

If field engineering teams are unable to visit a location to help with system troubleshooting and design challenges, or other matters, a remote format can be a welcome option. Though ideally there would be at least one field engineer onsite, it is also possible for facilities to use the AR headsets themselves, recording video while speaking with remote field engineers who provide real-time feedback. No matter how the virtual technology is deployed, virtual site visits allow facilities to minimise the amount of time their system issues go undiagnosed or unaddressed, while minimising travel-related costs and coordination of time.

Technology drives quality and efficiency

Though the importance of virtual site visits became even more critical as COVID-19 made onsite visits more difficult, the ongoing integration of AR technology has implications far beyond the pandemic. Being able to access worldwide experts virtually means troubleshooting capabilities can be broadened and consultations can perhaps be made available around the clock.

In addition, virtual site visits are ideal in situations in which in-person visits are difficult to manage, such as remote locations, offshore environments or other areas of restricted access. And since virtual visits are typically recorded, it allows field engineers to return to a visit using images and video to refresh their memories and ensure they do not miss anything.

The integration of AR technology into field engineering visits allows for faster deployment of resources and provides plants with access to a wider range of experts because the right specialists can be matched with the right challenges. Virtual visits also allow specialists to see the same thing at once without having to cycle specialists in and out of confined spaces. It also allows immediate collaboration between multiple experts to diagnose problems in real time.

Finally, virtual evaluations are also showing promise for getting end users quick recommendations to improve their facilities and systems — sometimes even the same day — thanks to the high level of collaboration the headsets enable.

A field engineer wearing an AR headset inspects critical equipment at a chemical plant with the help of an engineering team watching a livestream video and providing remote support.

Additional applications for virtual visit technology

Virtual visit technology is not limited to providing field engineering visits. Companies can use the headsets for:

- **Virtual commissioning of systems and advising on the construction and testing of equipment:** The AR headsets allow experts to be virtually present to provide oversight during key stages in the implementation of new facility systems, helping facilities avoid errors and perform optimised system integrations. Remote viewing also allows the organisation's executives to experience processes they would not usually be able to witness.
- **Virtual witnessing of key procurement processes:** Compliance teams can offer plants the opportunity to witness manufacturing and shipping practices that would usually require an onsite visit.
- **Virtual customer visits to manufacturing and fulfilment centres:** End users can also meet the people and see the processes behind the products and services they are purchasing, allowing them to take a tour of production facilities with an onsite tour guide.

Hosting virtual facility tours alongside relevant business meetings means manufacturers can provide the full experience of visiting their headquarters without requiring travel. It also allows manufacturers to reach more customers at once and expands the ability to meet with customers from around the world.

Virtual technology enables training

The expense and difficulty of travelling have not stopped essential work from continuing, which means training must continue as well. As an example, one of Australia's leading gas suppliers, which is focused on safely and sustainably developing natural gas resources to power industries and households around the country, recently faced the issue of how to continue its critical training programs when in-person meetings were restricted.

The solution was to create an all-virtual training program that would allow employees to learn about proper safety protocols at their facilities without all gathering in person. Such virtual training programs offer a number of potential opportunities.

Enhancing safety

Focusing employees' attention on even the most basic skills can be a welcome refresher to enhance their abilities and ensure they are up to speed and trained on the latest installation methods and operating procedures. That may mean incorporating specialised training programs into a facility's normal activities, with the best programs featuring both practical and written assessments to engage trainees. Refreshing employees' critical skills can reinforce best practices, helping facilities enhance safety across their operations. Such was the case for the Australian company, which deployed an extensive remote training program focused on tube fitting installation, inspection and tube bending to reduce the likelihood of loss of containment incidents — and thereby improve safety — at its five natural gas and LNG operations throughout the country.

Improving employee engagement

Taking the time to teach new skills and refresh old ones is an engaging experience for employees, even when training is done virtually. The key is to ensure the training is relevant to the employee's role at the company and can help them improve outcomes in their daily jobs, while also offering room to grow and thrive in both their current and future roles.

Increasing flexibility

Moving to a virtual training model also introduces flexibility for employees, the benefits of which can include:

- Smaller class sizes with greater opportunity for trainees to ask questions and build rapport with the instructor.
- Attendance flexibility, as trainees can attend sessions on mobile devices and laptops either from their facilities or their own homes.
- A greater blend of learning modes, which may include formal instruction and practical, hands-on training.

Saving money

Companies may also realise significant cost savings from virtual training — mainly because they no longer need to accommodate trainers onsite. This factor can help to significantly reduce per-trainee costs, while also allowing for the training to have a broader reach.

Scaling rapidly

To capitalise on growth potential, organisations must be able to quickly train staff with the skills required to implement new systems and operating procedures. Virtual training programs can help companies accomplish those training imperatives with greater flexibility and cost savings.

What the virtual revolution means for the future

As virtual meetings become the norm for both site visits and training, it is likely the technology will proliferate. Virtual site visits allow companies to get more detailed guidance on their facilities and systems. Specific experts can be accessed to provide additional expertise to site inspections and troubleshooting activities. In addition, virtual technology increases the ability of all parties to collaborate in real time, so problems do not go undiagnosed or uncorrected. The ability to solve problems more quickly saves downtime and repair costs in the process.

In addition, as corporations return to a 'new normal' during the continued pandemic, the advantages of holding virtual training sessions will remain. Whether it is providing flexibility to employees or saving costs for corporations, virtual training will offer opportunities for companies to reach a greater number of employees in a cost-effective manner.

Swagelok Corporation
www.swagelok.com

COMPACT PRESSURE SWITCHES

Krohne has introduced the OPTIBAR PSM 1010 and OPTIBAR PSM 2010 ultra-compact pressure switches for absolute and gauge pressure measurement in gases and liquids.

Both devices are aimed at basic automation applications such as hydrostatic level measurement in open tanks, dry-run protection of delivery pumps or pressure monitoring of compressors, hydraulic and pneumatic systems. Target industries include food and beverage, water and wastewater, environmental and OEM process equipment applications with restricted installation space.

The switches feature a 2-axis (multi-rotatable) display and adjustment module, a robust construction (IP67) and fully configurable communication outputs for all possible configurations: IO-Link and PNP/NPN as standard I/O, and 4–20 mA, 0–10 V or NPN/PNP as secondary output. Both devices offer high temperature stability due to digital compensation.

OPTIBAR PSM 1010 is suitable for liquids and gases from 0.1–600 bar (1.5–8700 psi) with process temperatures up to 125°C.

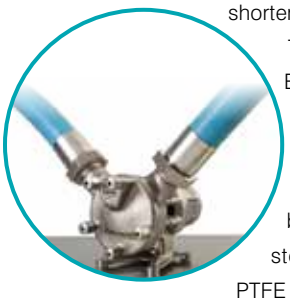
OPTIBAR PSM 2010 is aimed at hygienic applications in the food and beverage industry from 0.1–40 bar (4–580 psi) and a maximum temperature of +150°C. Its hygienic construction features a fully welded front-flush diaphragm to meet requirements in terms of crevice-free installation with several 3A-approved process connections.

KROHNE Australia Pty Ltd
www.krohne.com.au

FLEXIBLE HOSE ASSEMBLIES

AFLEX FaBLINE flexible hose assemblies offer a versatile hose solution that can be used throughout many different production processes. The hoses are said to carry up to twice the flow of similarly sized convoluted delivery hoses meaning that they can provide a faster, more efficient processing option.

The product's low-friction, smooth bore construction means that it can dispense viscous fluids to precise levels, whereas rubber hoses may become blocked or even burst when tasked with this same application. The high flow rates offered also mean that the load and unload times will be shorter, reducing the cost of processing.



The assemblies are offered in either EPDM or platinum cured silicone rubber and can have a range of end fittings attached. The hoses' conductive liners mean that static build-up can be prevented during steam or air-drying processes. The PTFE liner tubes are chemically resistant to CIP, SIP and autoclave conditions to allow for efficient and complete sterilisation.

Watson-Marlow Fluid Technology Group
www.wmftg.com.au

VACUUM CONTROLLER

Atlas Copco has developed the HEX@ vacuum controller for Industry 4.0. It serves as an enhanced control centre for vacuum pumps and systems and is designed to ensure higher vacuum performance and functionality across a large range of applications.

Featuring increased connectivity and system integration, the company says it has a clean and intuitive user interface. Users access key data directly on the home screen and can access further settings and controls easily using the on-display menu. Relevant pump data is displayed quickly and the controller can be individually configured by users so that only selected values, such as discharge temperature, power consumption or inlet pressure, are displayed.

The communication options for HEX@ enabled pumps allow users to access the pumps remotely using smartphones, tablets, laptops or a PC; alternatively, access can be via the onboard HMI interface or a local device connected to the machine using wired or Wi-Fi-based connections.

Users can choose to connect fully to their local network and the cloud. The device will also support other communication protocols such as EtherNet/IP, EtherCAT, Profinet, Modbus/TCP, Profibus and OPC UA.

Atlas Copco Compressors Australia
www.atlascopco.com.au

NEW PRODUCTS

CORIOLIS MASS FLOWMETERS

OVAL supplies three types of Coriolis mass flowmeters that are designed to be accurate, rugged and easy to use.

The ALTImass Type U is equipped with a transmitter providing self-diagnosis, a large size display and field reconfiguration capability using a touch panel. It is suitable for applications involving liquids and gases and requiring the measurement of extremely low flow, short-duration filling processes etc in addition to routine flowrate measurements.

The nominal size of the Type U is 250 mm and its flow range is 0 to 2,800,000 kg/h. Accuracy is ±0.1%RD for liquids and ±0.5%RD for gases, while the operating temperature range is from -200 to +200°C, with explosion-proof options available.

The vibration-resistant, single straight-tube model Type S is suitable for clean processes where the metered process fluid tends to build up or solidify, or where fast and positive process fluid replacement or draining of the pipeline is required.

The nominal size of the Type S is 10–80 mm, and it is suitable for liquid measurement in the flow range 0 to 91,800 kg/h. Accuracy is ±0.15%RD, and the operating temperature range is -40 to +13°C, with explosion-proof option.

Finally there is the compact general-purpose Type B for liquid measurement with a rainbow type flow tube. Nominal size is 10–50 mm, and the flow range is 0 to 96,000kg/h. Accuracy is ±0.2%RD (flow rate) and ±0.003 g/mL (density). The operating temperature range is -40 to +130°C, also with explosion-proof options.

Slentech Pty Ltd
www.slentech.com.au

MULTIFUNCTIONAL SENSOR

The ODT 3C sensor from Leuze is designed to handle both measuring and switching tasks. The 2-in-1 solution is therefore suitable for a wide range of automated industrial applications.

With the ODT 3C from Leuze, only a single device is needed: the sensor can perform both switching and measuring tasks in the machine control, which the company says makes it an efficient and economical 2-in-1 solution.

The sensor transmits measurement values and diagnostic data via IO-Link. The data includes temperature values, warnings and signal quality. It features black-and-white behaviour (<±3 mm at 150 mm). The operating range can be easily adjusted via the teach button, line or IO-Link.

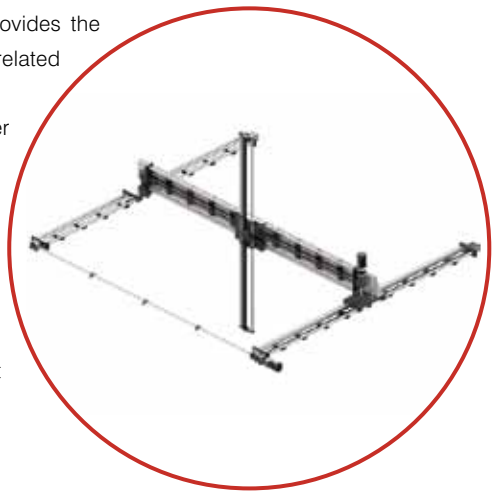
The sensor also offers functional reliability: active ambient light suppression prevents faulty switching, even when exposed to direct light from LED hall lighting systems. LEDs that are easily visible from all sides allow users to quickly read the status of the sensor. Two independent switching outputs and sensor models with warning output or a small light spot (pinpoint) round out the sensor's functions. This enables plant operators to use the ODT 3C flexibly in a wide range of applications.

Leuze electronic Pty Ltd
www.leuze.com.au

ENTRY-LEVEL LINEAR ROBOT

igus is expanding its automation range with the drylin XXL room linear robot. The linear robot has an action radius of 2 x 2 x 1.5 m and is suitable for palletising applications of up to 10 kg. The robot includes a control system, and is said to be easy to set up and program without the help of a system integrator.

Many small and medium-sized companies shy away from getting started with automation because of expense and complexity, jeopardising competitiveness in the long term. A DIY robotics kit provides the opportunity to quickly and easily put a pick-and-place linear robot into operation for tasks related to palletising, sorting, labelling and quality inspection.



The DIY linear robot kit consists of two toothed belt axes and a toothed rack cantilever axis with stepper motors. While the default action range is 2 x 2 x 1.5 m, extensions up to 6 x 6 x 1.5 m are also possible. The package includes a switch cabinet, cables and energy chains as well as the igus Robot Control (iRC) control software, which provides a digital twin of the linear robot that can be used to define movements with a few clicks.

igus sasy the system itself does not require any maintenance. The linear axes consist of corrosion-free aluminium and the carriages move via plain bearings made of high-performance plastic which, due to integrated solid lubricants, enable a low-friction dry operation without external lubricants for many years.

Treotham Automation Pty Ltd
www.treotham.com.au

GIANT KAISHAN COMPRESSORS TO MEET AUSTRALIAN NICKEL DEMAND

Australia is one of the world's largest nickel producers with multi-billion dollar sales per annum.

With an ever increasing demand for nickel in the manufacture of stainless steel and more recently as a major component in lithium batteries to store electricity from wind and solar installations, as well as to power the electric vehicles of today and the future, the demand for nickel is set to grow dramatically. The sustainable production of nickel is also essential to meet this future demand as the customers purchasing EVs want to know that the inputs to the manufacturing of these vehicles are also sustainable.

Nickel sulphide is mined before being crushed and concentrated using nickel sulphide floatation technology. The concentrate is then dried and smelted into a granulated matte of 68% pure nickel product. The refinery process converts this base product to 99.8% pure nickel metal powder and briquettes for the local and export markets. Australian refineries will also need to meet a rapidly expanding local and global demand for 99.99% pure nickel sulphate.

To power mining and refinery processes required to meet this rapidly growing demand, superseded compressors are being replaced with Kaishan KRSP 2-stage rotary screw compressors with integral variable speed control.

These compressors employ advanced 2-stage and variable speed technology to each produce compressed air at a rate of 70m^3/min at 10barg with a highly beneficial output to input energy ratio. The energy saving operation of these new-age compressors complements the green energy and sustainable production capabilities for Australia's nickel refining processes.

Each compressor is 4350 x 2200 x 2580 in size and weighs 11,500 kg, and is specially built to handle the hot, dusty and harsh conditions of mining and heavy industrial applications. The compressors will be maintained and serviced by Kaishan partner company, Hoerbiger.

Kaishan Compressors, through their global design and manufacturing facilities, have the capability to design, produce and install custom compressed air solutions for every application. The company supplies a wide range of air compressors from heavy duty rotary screw models to compact compressors for a range of general and specialised applications.

Kaishan Australia Pty Ltd
kaishan.com.au

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Dairy heat exchanger meets tight spec for Burra Foods

The unit had to connect to plate heat exchangers in a tight physical space.

Burra Foods is a leading Australian dairy ingredient processor, producing value-added dairy products for the global food manufacturing market. An upgrade at their processing plant in Korumburra, Victoria, necessitated the use of a heat exchanger to warm frozen milk products, but existing building and infrastructure meant that the available space was severely limited.

The line in question produces skimmed milk concentrate and cream from frozen concentrates which are then thermalised and cooled to ambient processing temperatures. The required heat exchangers needed to raise the temperature of the product from -5 to 18°C prior to the final heater, which includes melting the frozen product. After this the product is then cooled from 10 to 5°C in the final cooler. Due to the consistency of the skimmed milk concentrate and cream the product is quite viscous, so the heat exchanger needed to resist fouling and provide good heat transfer performance, while also integrating with the plate heat exchangers used in the process in an extremely limited footprint.

The solution was an HRS MI Series corrugated tube heat exchanger, which provided the necessary heating and cooling requirements in the tight space available and also resulted in a small pressure drop, another important consideration for this installation. Following an initial enquiry at the end of 2019, the unit was installed in mid-2020, and it has exceeded performance expectations since final commissioning, with a production capacity of 5000 kg of product per hour.

"Other suppliers couldn't match HRS's offering in terms of tubular heat exchangers and the level of detail provided," said Stuart Shattock, Process Engineering Manager at Burra Foods. "Once we placed the order, there was a slight delay due to COVID-19, but HRS managed to produce it as a rush order and the installation and commissioning was really smooth. In fact, they were able to accommodate a change to the process design partway through installation and make some improvements on the fly, which is great for a nimble and flexible food and beverage business like ourselves.

"There are two parts to the unit: the heater and the cooler. The heater has performed well and done exactly what we expected, while the cooler has actually done more than we expected. Overall, we are very happy with the product and the output from it."

"HRS's corrugated tube heat exchanger technology was required in order to prevent fouling from the thick cream element of the product," added Chris Little, Australian Director at HRS Heat Exchangers. "The requirement for a heat exchanger with a small physical footprint meant that coming up with the final design was a challenge, but our engineering team rose to the occasion and provided a reliable solution that meets all of Burra Foods' needs."

HRS Heat Exchangers Pty Ltd
www.hrs-heatexchangers.com/anz

AS I SEE IT

REMOTE CONNECTIVITY IN THE POST-COVID WORLD

I'm not sure what your experience may have been, but I'm certain everyone learnt something new during the COVID-19 pandemic lockdowns. Some learnt how to make sourdough bread, others learnt a how to play a musical instrument, some of us working from home learnt their partner's work voice — possibly much to our surprise.

However, I think there is one thing many people involved in various industries learnt during this time: just how disconnected from support they were when Australian state borders sprung up, the movement of people wasn't nearly as easy as it used to be, and the ability to get on-the-ground support suddenly became more difficult than many of us had ever imagined.

For my part, working closely with end users one thing became clear: the need for secure remote connectivity was real, and in some cases early adopters benefited in critical situations when the crunch came. Raising the need for secure remote connections pre-COVID often seemed like a luxury. "Why don't we just get someone in?" was the likely response and at the time if often seemed to make the most sense.

I saw many firsts during the last few years, and a number of those revolved around remote connectivity. I had never seen site implementation of a project supported remotely, until it was the only way it could happen. Through the use of secure channels a project was able to proceed as planned, and deadlines were met. If not for the infrastructure that was put in place back when it was a 'nice-to-have', these critical improvement projects would have been delayed for 12 months or longer.

It isn't hard to see why industrial facilities are now much more interested in exploring the different opportunities that connecting to the cloud (be that on-premise or not) presents. Information that until recently remained locked away from analysis is now finding its way to the right software, and more importantly the right people. The ability to drive improvement has always been based on having the right data, but accessing that data was a challenge that is becoming easier to solve.

While it is now very clear what the benefits are, the risks remain real and require thorough consideration. Implementing a cyber-secure solution is the key to realising the benefits while also remaining protected from very real threats. Each installation will have its own methodology, following an industry standard (such as IEC 62443) or a guideline such as the Essential Eight Maturity Model, but the advice remains consistent. The success of your project hinges on whether or not you have managed to implement the solution in a secure way.

It is my experience that restricting access to data, or remote assistance for that matter, is rapidly becoming anachronistic. All over the globe companies are changing their ways, perhaps as a result of the pandemic and perhaps not, but a connected future is a future full of possibility. The idea of allowing remote connectivity can still seem daunting, or even risky. However, like sourdough bread or musical instruments, it just takes some time and commitment and you can achieve something you never thought possible.

**Nick Meehan is Lifecycle Services Manager at Emerson Automation Solutions. Nick has worked in the automation industry for over nine years. He has a passion for solving challenges through the application of new technologies.*

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