PROCESS TECHNOLOGY

AUTOMATION + CONTROL + INSTRUMENTATION

June 2023 vol.37 no.1

PP100007403

MOORE INDUSTRIES
WORLDWIDE
Demand Moore Reliability

KEEP IT SAFE

The rugged and reliable FS Safety Series Instruments from Moore Industries

CONTROL DEVICES

DELIVERING YOU EXCELLENCE IN ENGINEERING

ROTARY SENSORS
LINEAR SENSORS
DRAW WIRE SENSORS
TILT SENSORS
INTERFACE MODULES
HAND CONTROLS
INDUSTRIAL JOYSTICKS
PANEL SWITCHES
USB DESKTOP JOYSTICKS
CONTROL LEVERS
HAND CONTROLS
FOOT PEDALS
FOOT SWITCHES
FLEXIBLE COUPLINGS
ACCELEROMETERS
INCLINOMETERS
PCB SWITCHES
TOGGLE SWITCHES
TACTILE SWITCHES
WATERPROOF SWITCHES
VACUUM SWITCHES
THERMAL SWITCHES
PRESSURE SWITCHES
AIR SWITCHES
GYROSCOPES

PRODUCT SHOWCASE

ANTI-VANDAL SWITCHES

POSITION LIMIT SWITCHES

LED INDICATORS

WIND SPEED SENSORS

LINEAR & ROTARY ENCODERS

DIGITAL PANEL METERS

MINIATURE JOYSTICKS

FINGERTIP JOYSTICKS

PENDANT CONTROL STATIONS

UPCOMING SHOWS

Visit us at IICA Institute of Instrumentation Control and Automation

IICA KWINANA (WA):
13th September 2023
IICA CAMPBELLTOWN (NSW):
11th October 2023

Certified System Quality ISO 9001 SAI GLOBAL

BRANDS WE REPRESENT

APEM mec CURTISS-WRIGHT DACO hand controllers DITEL lika seika
Germanjet PART OF YOUR POSITIONING MAKERSAN Herga EFC GILL POSITEK LIMITED GLADIATOR TER CPI Control Products, Inc.

www.controldevices.com.au sales@controldevices.net

Unit 13, 538 Gardeners Road Alexandria NSW 2015 02 9330 1700

0623

PROCESS TECHNOLOGY
JUNE 2023

CONTENTS

READ ONLINE!

This issue is available to read and download at
www.processonline.com.au/magazine

MOORE INDUSTRIES WORLDWIDE

Proudly sponsored by
www.miinet.com/safetyseries

ON THE COVER

Risk mitigation and the application of safety protection are not novel concepts in the industrial and automation industries. But subjective assessments and layers of safety protection that involve the application of devices and equipment can vary widely between countries and facilities. Fortunately, most industrial manufacturing and automation sectors have settled on best practices when assessing, implementing and selecting products that help accomplish safety goals.

Rugged and reliable FS Functional Safety Series instrumentation from Moore Industries can help ensure the safety of processes and facilities when it is most needed. The Moore Industries Functional Safety Logic Solver, Signal Isolators, Temperature Transmitters and Relay Module are built to strict IEC 61508 standards, ensuring safe and reliable operation — particularly where hazardous or emergency situations can occur. Components used in a Safety Instrumented System (SIS) should instill confidence and operational security. That is why all of Moore Industries' Functional Safety products are stringently reviewed and receive approval from exida for use in SIL 2 and SIL 3 safety instrumented functions. Often these products act as the last line of defence to protect the process, personnel and environment — KEEP IT SAFE with products designed to do so.

To learn more about the Moore Industries FS Functional Safety Series, call (02) 8536-7200 or go to www.miinet.com/safetyseries.

MOORE INDUSTRIES WORLDWIDE

Moore Industries Pacific Inc
www.miinet.com

SMART MANUFACTURING IN THE PROCESS INDUSTRIES

Smart manufacturing requires the organic linking of process, equipment, technologies and people to achieve stable, sustainable and profitable operations.

iStock.com/metamorworks

This issue is sponsored by — **Moore Industries** — www.miinet.com/safetyseries

Process industry manufacturers are under constant pressure to enhance profitability, improve capital efficiency and achieve sustainability in a business environment characterised by high volatility, uncertainty, complexity and ambiguity.

As a continuous and sustainable path towards growth and improvement, companies, partnerships and government agencies are leveraging the latest developments in digital technology, including new concepts such as smart manufacturing, Industry 4.0 and IIoT, in a process that requires collaboration among manufacturers, partners and other organisations.

Many advanced digital technologies such as artificial intelligence (AI), autonomous robots, cloud computing, intelligent sensor technology and augmented reality (AR) have become practical in terms of cost and value. The question is how to best take advantage of these technologies in an era of rapid technological change and massive competition. The goals of adopting these new technologies include total optimisation of efficiencies, flexibility and agility, safety and other operational improvements.

Background

The fast development and wide adoption of digital technologies are increasingly contributing to the efficiency and competitiveness of manufacturing industries. While digitalisation is still relatively new for many manufacturers, it has become a strategic imperative that underpins the survival of many organisations. All businesses must embrace digitalisation to be able to respond to rapidly changing market conditions and become part of a sustainable society.

For example, the camera film market has shrunk significantly since the introduction of digital cameras, thereby eliminating late adopters. Certain mainstream IT manufacturers have emerged as winners in the hypercompetitive world of PC manufacturing as a result of their supply chain reforms and implementation of one-to-one internet marketing. Thus, manufacturers must take note: the speed at which disruption is occurring means that manufacturers must continually transform their businesses and increase their competitiveness by applying digital technology and improving data utilisation. Waiting to undertake this type of transformation is not wise.

Survival in a continuously changing world requires the adoption of digitalisation on a scale that enables enhanced flexibility and agility that transcend the levels possible with conventional organisational silos. Implementation of vertical and horizontal integration and other means of collaboration are important enablers of these efforts.

Digital transformation can be defined as the novel use of digital technology to accelerate a company's business strategy. It is about the application of digital technologies to empower people, optimise processes and automate systems of the organisation to radically reorient its business performance. It is, however, important to consider issues such as leadership, new competencies and change management to ensure a successful digital transformation journey.

From industrial automation to industrial autonomy

The process industries have benefited significantly from industrial automation, and many applications have become fully automated and unmanned. The process industries will advance further towards industrial autonomy by focusing on areas of innovation such as predictive maintenance, smart energy consumption, routing flexibility, remote monitoring and control, human-robot collaboration, digital performance management, real-time supply chain optimisation, advanced process control, digital quality management and data-driven demand prediction. We can define industrial autonomy as the state in which plant assets and operations have learning and adaptive capabilities that enable responses with minimal human interaction, empowering operators to perform higher-level optimisation tasks. Digital technologies sit at the core of realising self-optimising manufacturing processes and industrial autonomy.

Industrial autonomy is different from industrial automation in many ways. Industrial automation involves performing a sequence of highly structured pre-programmed tasks, each of which requires human oversight and intervention in case something goes wrong (see Figure 1). In addition, between their pre-programmed tasks, humans must perform other ad hoc tasks and are ultimately responsible for the safe and profitable completion of entire procedures. Examples of procedures requiring significant human oversight and intervention include start-ups, shutdowns, grade changes, quality control adjustments and the managing of abnormal conditions.

Industrial autonomy transcends industrial automation by adding layers of intelligent sensing and artificial intelligence (AI) to anticipate and adapt to both known and unforeseen circumstances. This removes the need for constant human intervention. In a fully autonomous operation, the industrial autonomous system is responsible for all aspects of operation, from start-up to shutdown.

Within a plant, any process or operation can potentially be made autonomous. This includes manipulating and controlling the process, as well as performing other activities such as manufacturing operating procedures, planning and scheduling, supply chain activities, margin optimisation and compliance measures. It is also possible to make the operation of devices, equipment, units and business systems — or ideally entire plants — autonomous, so each is self-aware and able to understand and adapt to the context in which it operates.

The most forward-looking companies are beginning to think about autonomous operations, and some are achieving unattended remote operations. Many of the steps necessary to achieve remote operations are also needed to achieve autonomy.

For field operations, this means moving from an absence of autonomy, where all tasks are performed by humans, to mid-level autonomy, where the system identifies tasks and guides operators on what to do and provides instruction on how to accomplish each task. Further along the autonomy journey, manual tasks must be converted to fully automated tasks, with human action only required as an exception. Fully autonomous operations require no human interaction. At this level, robotics plays a key role by conducting routine operator rounds and collecting samples and by performing monitoring, inspection and surveillance. Robots will thus perform all necessary field operations and maintenance tasks.

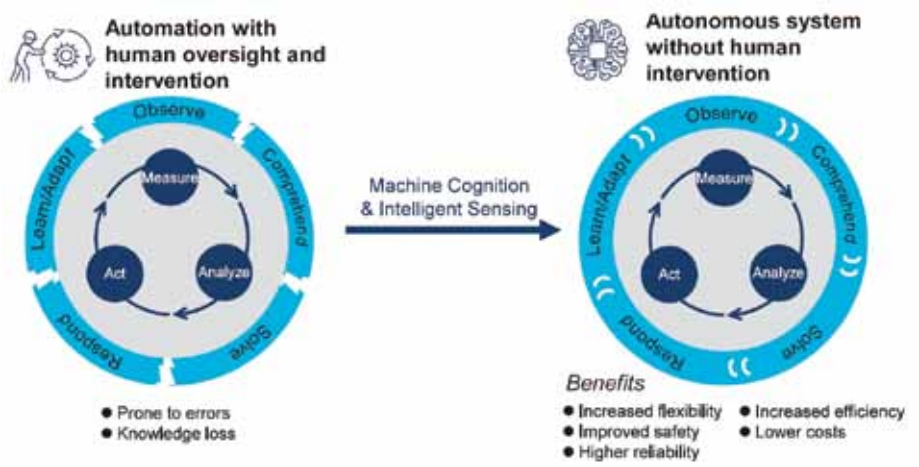


Figure 1: Industrial autonomy enhances industrial automation.

Process industry manufacturers will need to implement industrial autonomy sooner rather than later to improve productivity, flexibility and profitability. Industrial autonomy will also reduce human errors, remove people from hazardous environments and help compensate for the loss of experienced workers due to the 'great crew change'.

In certain industries, completely autonomous plants are unlikely in the near future. However, it is reasonable to expect that certain functions will be autonomous based on the application, needs and cost/benefit ratio. In these cases, human intervention and decision-making will continue to be important as plant personnel learn to work alongside autonomous systems.

Figure 2: Connectivity beyond plants and organisations at the cloud and IIoT levels.

Smart manufacturing in the process industries

Smart manufacturing is defined by ISO and IEC as follows:

Manufacturing that improves its performance aspects with integrated and intelligent use of processes and resources in cyber, physical and human spheres to create and deliver products and services, which also collaborates with other domains within enterprises' value chains.

The scope of smart manufacturing is broad and involves a journey. Connectivity beyond plants and enterprises at the IIoT and cloud levels provides seamless integration of data, including supply chain information, leading to smart manufacturing (see Figure 2).

To implement smart manufacturing, it is necessary to not only introduce new technologies as they become available but also prioritise the adoption of each solution based on a coherent vision of the future, along with analyses of the status quo and problems and their expected outcomes.

For many organisations, autonomous operations is the destination to achieve their smart manufacturing goals.

Integrating information to implement smart manufacturing

Many diverse problems hinder the realisation of smart manufacturing. For example, there may be difficulties with integration among systems because of cybersecurity requirements, organisational issues related to empowering employees and inconsistencies in information, demand prediction accuracy and other issues. From a broader perspective, there are many other issues that cannot be managed internally, such as drastic changes in economies and markets.

This issue is sponsored by — **Moore Industries** — www.miinet.com/safetyseries

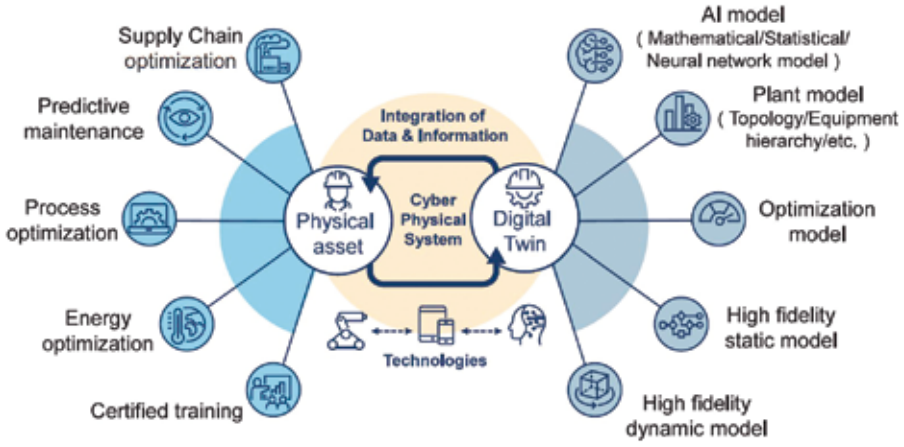


Figure 3: Information integration and digital twins allow organisations to benefit from the latest technologies.

While there are many existing technologies for smart manufacturing implementations, no simple and general methodology has been established to dictate which technologies should be selected to enable smart manufacturing. Processes, technologies and people need to be linked to realise smart manufacturing, and by integrating systems and data, predictive and quick actions along with adoption of the latest technologies such as digital twins will lead to successful smart manufacturing goals (see Figure 3).

To transform data into information, organisations need to acquire accurate and reliable data and utilise it more quickly by turning it into usable and valuable information. This goal has been difficult to achieve with hierarchical systems, communications and organisations. By establishing vertical and horizontal integration and analysing information, the ability of process industry manufacturers to achieve these goals will be greatly increased.

The integration of systems through a digital transformation platform

To realise smart manufacturing, solutions are required to measure and transform plant data into valuable information and intelligence, regardless of whether an organisation stores their data on premises or in the cloud. To effectively use these solutions and applications, the seamless integration of systems is important. Connectivity beyond plants and enterprises at the IIoT and cloud levels enables the seamless integration of business, production and supply chain data.

Traditionally, process manufacturing operations are built and engineered to include a wide variety of mission-critical equipment, control systems and human-machine interfaces. Most of these items incorporate software, and all require some form of system integration. Common items include distributed control systems, safety instrumented systems, tank gauging systems, programmable logic controllers and other automation components. These components receive inputs from instruments, analysers and other field devices. Software logic is applied to these inputs to drive outputs to valves, motors and other equipment.

For capital projects, most design efforts are completed up-front on a one-time basis, with little or no formal plan for changes over the entire process plant operation lifecycle.

To support long-term flexibility and continuous asset and technology updates, OT architectures are moving towards open, modular and interoperable frameworks with strong cybersecurity — such as the Open Process Automation Forum (OPAF) framework.

One outcome of this will be the decoupling of the hardware used for control from the software performing the control functions. This will enable radically different automation system architectures to be created using a small number of commercial off-the-shelf IT hardware in addition to software building blocks, creating a new generation of state-of-the-art automation software.

This new approach will create a high degree of interoperability at the plant floor level, which will also be needed across a company's broader IT systems. Therefore, a comprehensive view of software architecture must be considered holistically across the organisation.

A new hybrid architecture is needed to integrate OT with IT systems and develop future applications. Such a digital transformation platform can also be used to connect with IIoT devices and cloud-based systems. Edge systems are an important starting point for the convergence of OT and IT. An ideal digital solution is realised by combining edge and cloud data hosted by an on-premise or cloud-based engineering and solutions application.

This digital transformation platform is used to create new opportunities, such as:

- **Flexible and scalable connectivity:** The traditional connectivity achieved through wiring and lots of software configuration makes data availability expensive. Digital transformation requires data and is characterised as flexible, scalable and affordable.
- **Accessibility:** The central deployment of data, information and applications makes it easy for the user for gain secure access to the digital system to obtain relevant information.
- **Availability and sustainability:** Digital transformation solutions have been proven to be reliable, and in conjunction with critical information that is still kept on premises, the solutions become sustainable.

The integration of plant asset information and the automation of engineering

In a smart process plant, information must be handled all the way from the equipment level to the plant level. Plant asset designs can change daily based on feasibility studies of front-end engineering design, detailed design, operation, and decommissioning. In many cases, plant data is designed separately for each purpose, but this data should be maintained consistently throughout the asset lifecycle.

With the right technology and planning it is possible to expand the automation of engineering and the automatic diagnosis of assets. The integration and management of disparate plant data and transforming the data into information provides knowledge and intelligence for multipurpose use throughout the asset lifecycle. This can be done by leveraging digital data, modelling technology, knowledge management, digital twins and information integration.

Conclusion

Smart manufacturing requires the organic linking of process, equipment, technologies, and people to achieve stable, sustainable, and profitable operations, utilising the latest technologies, integrated information systems, and applications such as digital twins as key elements. Taking advantage of these technologies in an era of rapid technological change and massive competition requires a future vision and an understanding of the reality of plant floor operations.

Yokogawa

www.yokogawa.com/au

HOT PRODUCTS
ON WWW.PROCESSONLINE.COM.AU THIS MONTH

RFID READ/WRITE DEVICE

The F191 UHF RFID read/write device can be commissioned, without time-consuming programming, via the integrated IO-Link interface.

Pepperl+Fuchs (Aust) Pty Ltd

https://bit.ly/3WMS8UD

PRESSURE GAUGE WITH BLUETOOTH

The Ralston Field Gauge LC20 data logging pressure gauge with Bluetooth permits the logging of pressure from a safe distance.

Ralston Instruments LLC

https://bit.ly/3C91DE8

EDGE COMPUTER

The ARK-3534 is a high-performance edge computer powered by 12th and 13th Gen Intel Core i processors.

Advantech Australia Pty Ltd

https://bit.ly/3N8Lgh6

HYGIENIC ENCLOSURES

The ILME T-TYPE Hygienic enclosures series is designed to be suitable for food industry applications.

Treotham Automation Pty Ltd

https://bit.ly/43i3TF7

This issue is sponsored by — **Moore Industries** — www.miinet.com/safetyseries

Contract manufacturer uses edge technology to improve product quality

Federal Package, based in Chanhassen, Minnesota, is the preferred contract manufacturer for many well-known brands. The company specialises in the development and packaging of a wide range of health, beauty and personal care products including deodorants, sunscreens, lip balms, serums and a variety of lotions and creams. It prides itself on delivering a quality product that supports its customer's brand image.

A recent project at Federal Package that involved producing deodorant for a personal care company helped spur the investment in automated inspection. There were two inspection points within the manufacturing process that were good candidates for automation. One was checking the plastic packaging that housed deodorant for drips that not only indicated overfilling but also resulted in a poor product presentation. The second quality checkpoint was label inspection. This involved verifying that the correct label was used and that it was applied in the correct position and orientation on the packaging.

The production line that Federal Package planned to use for this project required operators to manually inspect products after they were filled. To improve productivity and increase quality, automated inspection of each package was an ideal solution.

Federal Package has invested in machine vision in various areas of its business and has had previous experience with Cognex, which led the company to select Cognex the next time it needed a vision system, which presented itself with this new deodorant inspection application.

Cognex Account Engineer Nick Raddatz introduced one of Cognex's newest 2D vision systems that featured edge-learning technology embedded in the device. Edge learning is a subset of artificial intelligence (AI) in which processing takes place on-device, or 'at the edge' of where the data originates, using a pre-trained set of algorithms. The technology is simple to set up, requiring less time and fewer images for training compared to other AI-based solutions, like deep learning.

Noah Leuer, a manufacturing engineer at Federal Package, felt this new vision system could do the job and the company bought both a colour and a monochrome system. They used the monochrome version for drip inspection and the colour version for label inspection, as it could more effectively differentiate between the label boundary and the body of the deodorant container.

The drip inspection system evaluated each deodorant package body for excess deodorant that resulted from overfilling. If there was any sign of deodorant on the outside of a package, that unit would be rejected.

"We have between 30 and 40 different deodorant designs which include different fragrances and colours, which means there are many different colours associated with the containers that the camera sees," Leuer said. "After trialling the system, we learned that the system's edge-learning capability was intelligent enough to filter out the colours and focus on the actual defects in the product."

The drip inspection line runs close to 80 units per minute and the label inspection line runs around 60 units per minute. In both cases, the automation enabled more throughput, as well as guaranteeing all units were inspected, which manual inspection could not achieve. The company's accuracy rate for catching defects is now over 99%, which means minimal human intervention to remedy the few defective units that get through the inspection.

Once initially installed on the line, the vision systems were deployed on the production line within an hour. This ease of use enabled Leuer to hand off the setup of the vision systems to the maintenance department, which allowed him to address other automation projects.

Multiple varieties of container types with different colours and labels also meant frequent changeovers. However, the automated inspection system handled the changeovers easily.

"The edge learning classify tool enabled us to quickly train the system with images of both good and bad examples, which simplified changeovers to different types of deodorant products," Leuer said.

Training the system for new product runs only took 5 or 10 minutes, which helped maximise operational efficiency. In addition, Federal Package found that it did not need to retrain the system as often as expected, which saved time and increased the efficiency of the line.

The new edge learning-based automated inspection system that was put in place has enhanced Federal Packaging's quality assurance process.

Federal Package has also invested in a Cognex AI-based vision system that it plans to use to verify date and lot codes that must be printed on its products to enable tracking through the supply chain for inventory management and lot control as required by its customers and the FDA. As its business continues to grow, Federal Package plans to add more Cognex vision systems across various lines to enhance end-of-the-line product quality where it makes sense.

Automation Systems and Controls Pty Ltd
www.asconline.com.au

OVERCURRENT PROTECTION FOR Ex AREAS

The customisable Caparoc circuit breaker system from Phoenix Contact now offers modules for explosion-protected areas, extending the range of possible applications.

A wide range of power modules and circuit breaker modules can be combined to create a customised system that is tailored directly to the user's specific needs and requirements. The Caparoc PM S-R EX power module and the added adjustable, two-channel circuit breaker modules protect loads in explosion-protected areas against overload and short-circuit currents, with Ex e approvals for Zone 2.

The PM S-R EX module's operating voltage range is 10–30 VDC with a rated current of up to 45 A and a rated surge voltage of up to 500 V. Its push-in connectors support conductor cross-sections from 0.5 to 16 mm^2. Status is indicated by red and green LED indicators.

Phoenix Contact Pty Ltd
www.phoenixcontact.com.au

IoT MODEM

The Webdyn EasyTunnel 4G is an all-in-one IoT solution for industrial, agricultural, utility and environmental applications.

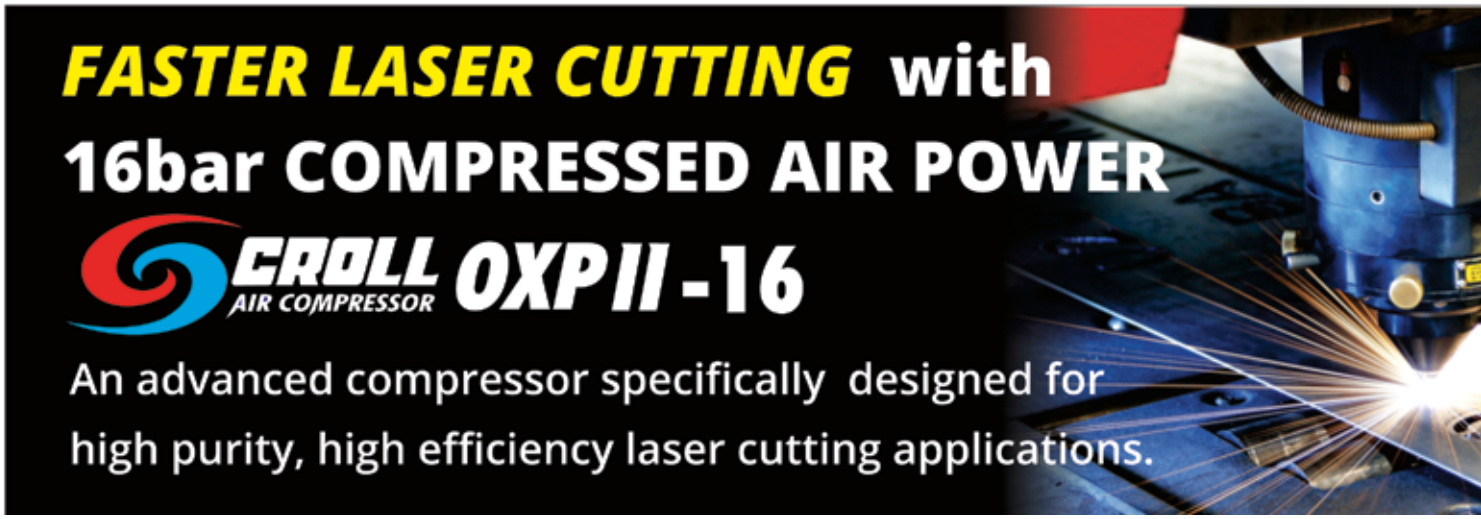
With RS232, RS485, dual SIM and digital I/O interfaces, and embedded TITAN V6 firmware, the unit provides the required functionality for many complex IoT projects.

A key feature of the Webdyn EasyTunnel is the user-programmable scripts, based on JAVASCRIPT, that permit easy programming of customised functions for specific applications. Additional functions include FIFO/LIFO modes for data queuing, SSL/TLS support and data sending options including HTTPS, FTP and MQTT with custom JSON formats.

Webdyn's Titan V6 firmware with an embedded webserver make configuration and set-up simple and quick. Additional features of the Titan V6 firmware include two simultaneous 4G-to-RS232/485 connections, full control by SMS with phone number authorisations, various alarms, full management with AT Command by serial, socket, SMS, Modbus and SNMP, SSH encryption which supports TACACS+ and IEC 60870-5-102 protocol support for meter reading.

Industry 4.0 applications include gathering data from electrical meters, monitoring solar/photovoltaic systems, monitoring frequency drives used in pumping or other applications, temperature and humidity monitoring, irrigation pump control and water metering.

Australis M2M Pty Ltd
australism2m.com.au



This issue is sponsored by — **Moore Industries** — www.miinet.com/safetyseries

DISPLAYPORT AND USB EXTENDER

Interworld Electronics has introduced the XTENDEX 4K DisplayPort USB KVM HDBaseT Extender from NTI.

The XTENDEX 4K DisplayPort USB KVM HDBaseT Extender transmits an uncompressed digital Ultra-HD 4Kx2K 30 Hz 4:4:4 DisplayPort signal, transparent USB and RS232 up to 100 m over a single CATx cable using HDBaseT technology. Each extender consists of a local unit that connects to a computer and a remote unit that connects to a UHD DisplayPort display and four USB 2.0 devices, allowing users to extend a keyboard, mouse and other peripheral devices over long distances with ease. This makes it suitable for a wide range of applications, including control rooms, manufacturing and other process control environments.

The XTENDEX ST-C6USBDP4K-328 has a wide operating temperature range (-10 to 45°C) and is encased in a tough metal casing, enabling it to withstand harsh industrial environments. This means that it can be used continuously for long periods of time in applications such as process control, factory automation and warehousing, even when it is exposed to rough handling and heavy impact.

It also supports a number of DisplayPort features including DisplayPort 1.2a, 48-bit colour, RGB, YCbCr 4:4:4, LPCM, Dolby TrueHD, DTS-HD Master Audio and 3D. It also comes with an integrated mounting bracket that allows for easy surface or wall mounting and includes a plug-and-play design that requires no software or drivers to install.

Interworld Electronics and Computer Industries
www.ieci.com.au

LEVEL PROBE FOR THE WATER INDUSTRY

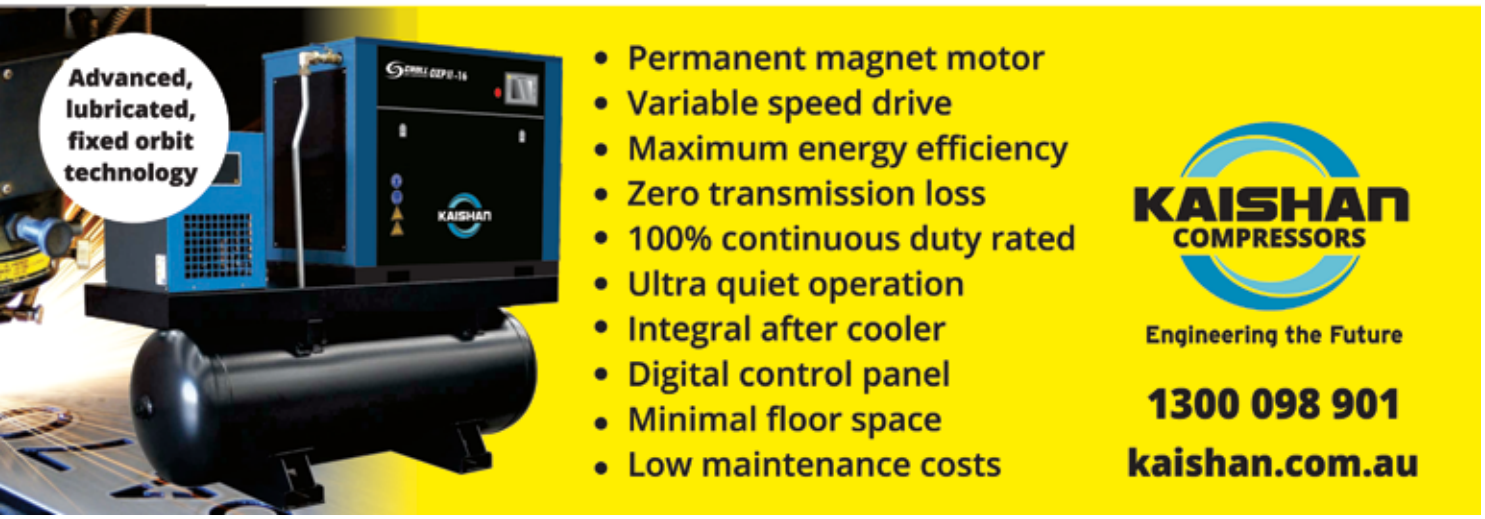
Bestech Australia has introduced a high-accuracy level transmitter from KELLER, the 26X, for water level measurement in the wastewater treatment industry.

The KELLER 26X level probe is designed to provide highly accurate measurement results with long-term stability. The measurement data is mathematically compensated via the in-built microcontroller technology to correct for temperature fluctuations and non-linearity.

This level transmitter provides serial RS485 data output with Modbus RTU protocol, but can also provide an analog 4–20 mA output signal. The robust stainless steel housing with IP68 and lightning protection allows the sensor to be used for long-term operation with minimum maintenance. The 26X is typically used for hydrostatic pressure measurements, such as groundwater, surface water, water tank and fuel tank measurements.

It has a fully welded construction and can measure up to 250 m of water column with 0.1% FS accuracy.

Bestech Australia Pty Ltd
www.bestech.com.au



NEW PRODUCTS

FANLESS INDUSTRIAL PC

The Vecow ECX-1000, available through authorised distributor LAPP Australia, is a workstation-grade fanless industrial PC with a wide operating temperature range of -40 to 75°C. The IPC's housing is built with fins for effective heat conduction. The ECX-1000 PC has a Vecow motherboard supporting Intel Xeon Core i7/5 /i3 processors with nine independent gigabytes of LAN connections and four PoE+ connections for external connectivity.

The ECX-1000 includes dual SIM sockets for Wi-Fi and 4G/3G/LTE/GPRS/UMTS redundant internet connections. The Intel industrial-grade processor offers high performance with low power consumption.

The rear and front panels provide the six USB 3.1 connections, four RS-232/422/485 connections and 16 isolated digital I/O. An expansion option allows for up to five Mini-PCIe cards and the unit is powered by a 6–36 VDC power input with 80 V in-built surge protection, with configurable ignition power control.

LAPP Australia Pty Ltd
lappaustralia.com.au

MULTIPORT FIREWALL

Belden has announced the Hirschmann EAGLE40 next-generation multiport firewall, which the company says offers optimal cybersecurity for industrial and process automation systems by hardening networks at the factory-floor level.

With multiport configuration, the ruggedised EAGLE40 is designed to support maximum data throughput without compromising on performance or uptime. Combined with ongoing software enhancements, this firewall is an economically sound solution for protection against the evolving cyber landscape.

The EAGLE40 offers improved performance, with more port options, increased bandwidth and encryption capabilities. A streamlined configuration is achieved through a user-friendly interface, a firewall learning mode and deep packet inspection modules.

An IPsec VPN allows secure data encryption and dynamic-routing support with OSPF and VRRP router redundancy. It also has a convection-cooled metal housing; three Gigabit Ethernet ports supporting up to 1 Gbps SPI firewall throughput.

Belden Australia Pty Ltd
www.belden.com

ELECTROMAGNETIC FLOW CONVERTER

KROHNE has announced the IFC 400 electromagnetic flow converter, which combines with Krohne's OPTIFLUX 4000 to create the OPTIFLUX 4400 electromagnetic flowmeter.

The IFC 400 helps detect external influences such as excessive vibration, temperature extremes and magnetic field effects, and also detects process influences like chemicals and excessive sedimentation in the liquid.

To detect these influences, the flow converter has a self-diagnostic function covering three aspects: process conditions, device functioning and out-of-spec testing. The process measurement check detects leakages, contamination, liner deformation and air entrainment in the process liquid. The device function self-check continuously monitors electronics and sensor hardware. Out-of-spec testing detects any sudden unexplained flow changes, linearity issues and uncertain measurements.

The product comes in a compact version (IFC 400 C) and a field-mounted version (IFC 400 F). Both versions feature an aluminium housing that can either be wall or rack mounted. The device has the diagnostics needed for advanced requirements, such as NE 107, and also has ATEX and IECEx certifications.

The 4-wire device provides a variety of outputs. It has 4–20 mA analog outputs and discrete outputs including frequency, pulse and status. Its digital outputs include the HART 7 protocol. When combined with Krohne's OPTIFLUX 4000 flow sensor, the two form the SIL2/3 certified OPTIFLUX 4400 electromagnetic flowmeter, suitable for safety instrumented systems (SIS) and applications that require high accuracy.

KROHNE Australia Pty Ltd
www.krohne.com.au

This issue is sponsored by — **Moore Industries** — www.miinet.com/safetyseries

PHOTOELECTRIC SENSORS

IDEC Corporation has introduced the SA2E photoelectric sensor range in five models, each of which improves on or replaces the company's previous SA1E sensors. An updated ASIC provides improved performance, while delivering better response times and more capable detection.

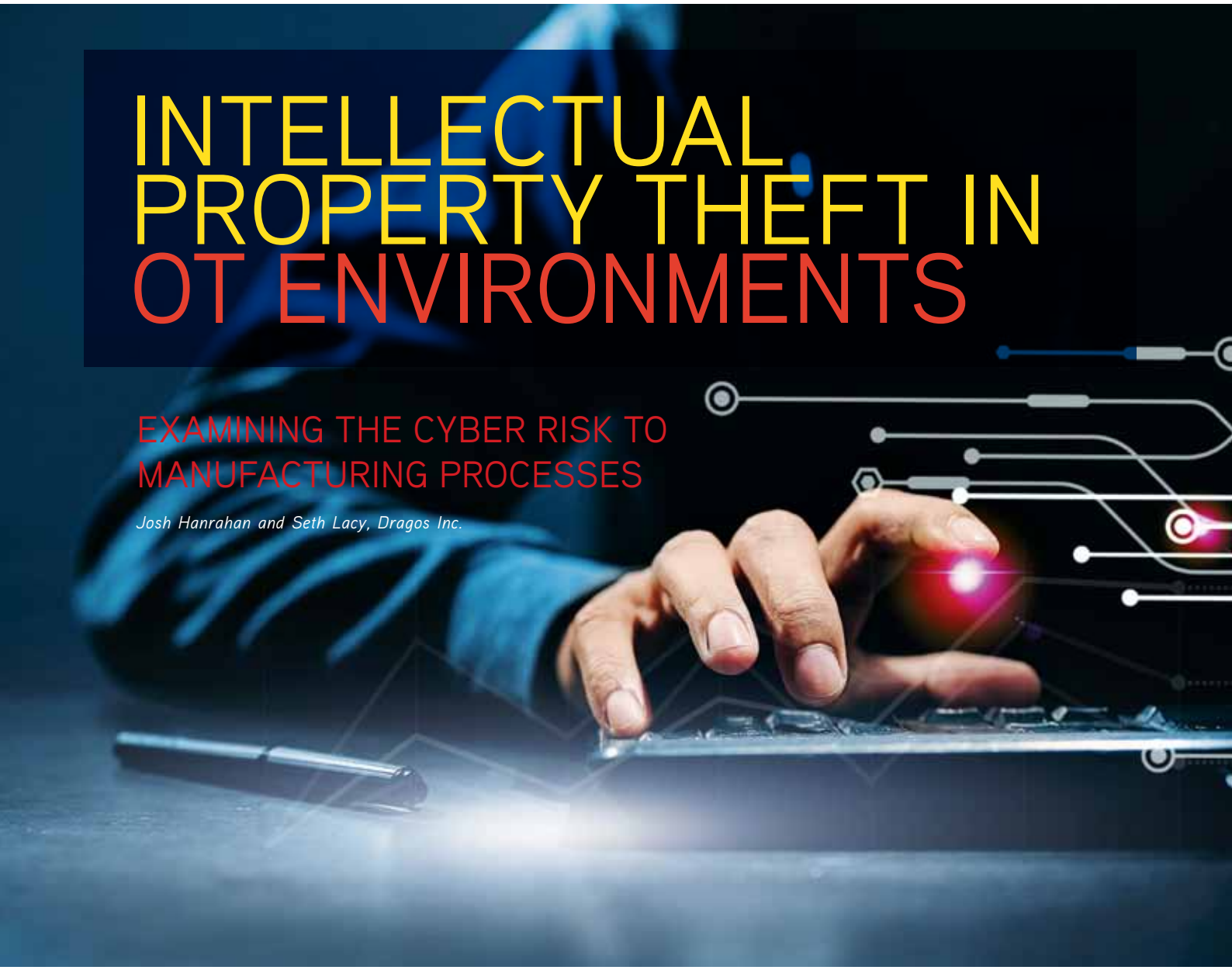
SA2E sensors are offered in five major variations: a through-beam sensor pair; polarised retro-reflective; diffused-reflective, for detecting targets by the light reflected from the target; background-suppression reflective; and small-beam reflective, for close detection of small targets.

The SA2E sensors generally improve response times to 0.5 ms, compared with 1.0 ms for previous generation models, for better detection of smaller and faster moving objects. Sensors are switchable between 'light-on' and 'dark-on' operating modes, and applicable models have an onboard sensitivity or range adjustment potentiometer. Depending on the model, sensing distances can range up to 20 m for through-beam, up to 5 m for retro-reflective and between 10 and 1000 mm for other reflective models. Tighter beams and more adjustability helps designers deploy the sensors in a greater variety of applications.

Electrically, the control output is connectable as NPN/PNP open collector with output reverse-polarity protection. The devices consume very low current on the order of 20–35 mA, at supply voltages of 12–24 VDC, with the ability to switch up to 100 mA maximum. Designers can choose models with cables or onboard M8 connectors for use with straight and right-angle cables.

SA2E PE sensors are compact at 10.8 x 19.5 x 31.5 mm, and various mounting brackets are available.

IDEC Australia Pty Ltd
www.idec.com/australia



INTELLECTUAL PROPERTY THEFT IN OT ENVIRONMENTS

EXAMINING THE CYBER RISK TO MANUFACTURING PROCESSES

Josh Hanrahan and Seth Lacy, Dragos Inc.

Even if well guarded in IT networks, intellectual property is also encoded into OT processes, making it possible for adversaries to steal it by OT network infiltration.

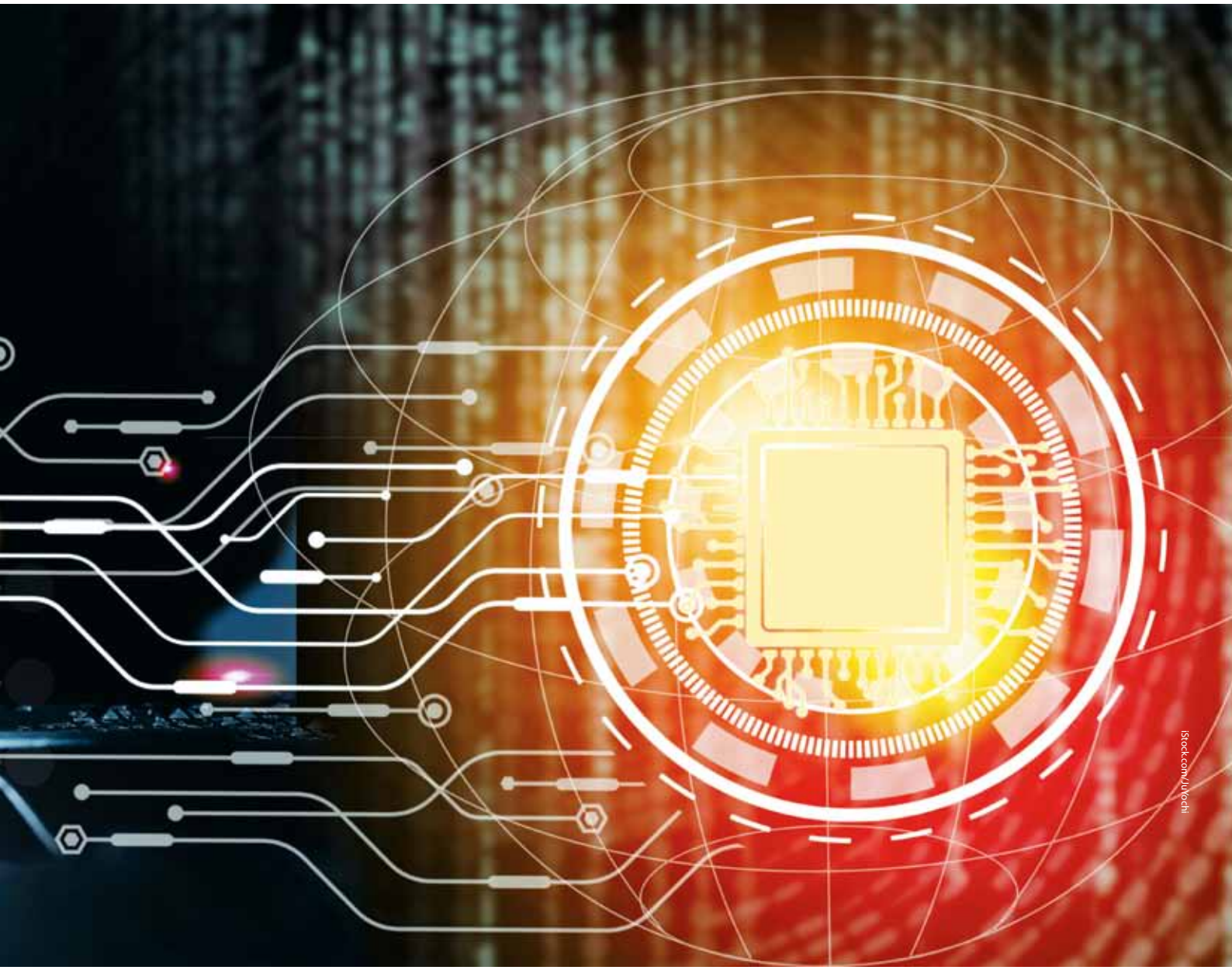
Intellectual property (IP) theft as a component of broader adversary information operations is an enduring and acknowledged risk, but one which is more often referenced in relation to enterprise IT environments than operational technology (OT) networks. This does not mean that OT networks are somehow immune from this threat — in fact, given that in many cases IP information is hardcoded into the processes OT networks manage, they should be prioritised for protection from the risk of IP theft.

IT and OT networks are increasingly interconnected, and efforts to support digital transformations continue to blur the boundaries between these previously distinct network domains. The imperatives for remote work and remote access imposed by the COVID-19 pandemic only served to accelerate this new paradigm of interconnectivity.

Increasing interconnectivity between IT and OT networks creates opportunities and incentives for adversaries to pursue their IP theft objectives within OT network environments, particularly if the adversary cannot meet their objectives through enterprise IT network compromise alone. For network defenders, it is important to consider the risk of IP theft in OT environments within the wider context of industrial espionage.

The US consulting firm Deloitte has studied and attempted to quantify the risks to a business of IP theft through cyber espionage, concluding that "IP theft has ramifications that are harder to grasp: fewer up-front, direct costs but potential impacts that might metastasize over months and years. Theft of personally identifiable information (PII) might quickly cost customers, credit ratings and brand reputation; losing IP could mean forfeiture of first-to-market advantage, loss of profitability or — in the worst case — losing entire lines of business to competitors or counterfeiters."[1]

This issue is sponsored by — **Moore Industries** — www.miinet.com/safetyseries



iStock.com/Jirsak

Given the potentially high returns on time and effort invested for those adversaries focused on IP theft, it's not surprising that the security community has observed multiple groups targeting networks in pursuit of protected IP for over a decade. While many of these incidents have historically been detected in enterprise IT environments, this disproportion is also influenced by disparities in visibility and monitoring between the two network types. The scope of the incidents is indicative of the extent of the potential threat and OT networks themselves have not been excluded from adversary targeting and operations.

Adversaries are most likely to pursue IP theft in OT environments as part of a broad campaign and the sensitive information an adversary can acquire from an OT network may not be available in other parts of a company's network. Within enterprise IT network segments, sensitive IP is increasingly stored offline or within closely guarded network enclaves. In contrast, on the OT side of the network, this IP is likely to be embedded into the processes the OT network manages and may be impossible to separate from the OT network's operation.

This potential disparity in information availability and protection could drive an adversary to pursue information from an OT network that they cannot access in other parts of a company's networks.

Manufacturing process influence on information availability

The type and value of information that can be extracted from an OT network by a motivated adversary will depend in part on what type of manufacturing process the targeted network manages, whether it be a batch, continuous or discrete process.

The differences between the three types of process influence the type of information an adversary would hope to obtain when targeting IP in an OT network environment, as well as additional data an adversary might pursue from other networks and sources. This also influences how damaging the loss of proprietary information from an OT network could be, depending on the sensitivity of the information in question.

Batch manufacturing

Batch manufacturing processes are likely to be lucrative for an adversary from the perspective of IP theft. The step-by-step nature of batch processing, and the fact that each step must be completed in its entirety before moving to the next step in the process, could provide an adversary an opportunity to extract the amounts of each input into the process and the set points from the controllers for the equipment involved in the process.

This would require the adversary to observe the batch process from start to finish as the raw materials and ultimately product moved through each of the distinct steps. The total time to completion for a batch process may influence the amount of time an adversary would need to be in the OT network and observing the process to be able to potentially reverse engineer the totality of the process.

A data historian overseeing and recording data on a network's operation can be a logical initial target for an adversary attempting to gather IP information out of an OT network overseeing a batch manufacturing process, as these devices aggregate and store data over a longer time horizon. That said, in some cases the information held by the historian may be raw sensor data lacking the necessary context. This lack of context can sometimes be a purposeful design decision in networks overseeing processes derived from sensitive IP. In these cases, HMIs or SCADA devices can also be important targets, as their data is meant for operator consumption and therefore unit-scaled with full context.

Recipes are the most sensitive category of IP for many companies in the pharmaceutical, chemical, and food and beverage industries. In some instances, this category of IP can represent billions of dollars in research and development for new pharmaceuticals and chemicals, and its loss or theft by an adversary could have significant repercussions for the competitiveness and profitability of the company targeted by an adversary.

Continuous manufacturing

Continuous manufacturing processes share many similarities with batch manufacturing in that predetermined amounts of raw ingredients are combined and modified by equipment to produce expected quantities of a finished product. The main difference is that the materials in continuous manufacturing move seamlessly through the steps of the process without pause. The product is tested throughout the process for adherence to expected quality levels.

The set point values for the controllers managing a continuous process are always active, and a properly functioning continuous process should not vary over time under normal circumstances. If an adversary can capture a snapshot of the set point values for a continuous process even over a relatively short time horizon (measured in minutes, not hours), and if that data is sufficiently rich in context, the adversary may have all the information they need to reverse engineer the process in question.

While data historians remain a logical initial target for an adversary targeting IP contained within a continuous manufacturing environment, the same caveats from batch manufacturing environments surrounding the level of context contained within the historian's data still apply. If this data lacks context based on purposeful or incidental design, an adversary may need to seek additional context from unit-scaled data in an HMI, SCADA or similar operator-focused device.

Discrete manufacturing

Given the fixed inputs that characterise discrete manufacturing, there is generally less information of relevance from an IP theft perspective for an adversary to extract from an OT network overseeing a discrete manufacturing process. That said, there is some information of interest or value for adversaries contained within these networks.

In the case of discrete manufacturing, rather than being interested in the components and inputs that result in a finished product (much of which could be determined through examination of a bill of materials or disassembly and reverse engineering), an adversary would instead be seeking information on the manufacturing process itself. Information on manufacturing processes can be significant, as efficiencies in these processes can allow a company to produce a certain product more quickly and at a lower cost, which in turn enables the company to offer the product to consumers at a lower price while maintaining an acceptable profit margin.

These types of processing efficiencies can be vital in maintaining a company's competitive edge, particularly in industries and products where the main differentiating factor from competitors' offerings is price. In these instances, information gleaned from an OT network on the layout, functionality and configuration of the network's components could be of value from the perspective of an adversary, especially if combined with additional information on engineering and design from other networks and sources — for example, network and engineering diagrams from an OT systems integrator.

Implications beyond information loss

While adversaries may target an OT network with the goal of extracting specific information relevant to a company's closely held IP, the loss of this information may not be the extent of their impact

This issue is sponsored by — **Moore Industries** — www.miinet.com/safetyseries

Figure 1: Five critical controls for OT cybersecurity.

on a company's operations. The general fragility of OT networks and the necessity of uninterrupted availability in most instances mean that even skilled adversaries run the risk of having a negative impact on the operations of an OT network they do not fully understand, particularly from a process perspective.

This risk could be amplified in instances where an adversary whose primary responsibility is targeting IP on enterprise IT networks pursues IP within an OT environment. An adversary 'learning' about ICS and industrial processes within an OT network is at high risk of causing unintentional disruptions and network failures. As an example, an adversary actively scanning with a tool like Nmap, which adversaries commonly deploy in the discovery phase of MITRE's enterprise ATT&CK matrix, is at high risk of placing industrial devices into a denial-of-service state and taking down an OT network when the adversary runs the same tool in an industrial environment.

Even in the case of skilled adversaries, who understand the functionality of OT networks and the constraints necessary to interact with the networks with minimal risk of disruption, there can be tension between the pursuit of IP and the preservation of network availability. This can be further influenced by the level of the network where adversaries are seeking information.

The manipulation or exploitation, deliberate or unintentional, of HMI, SCADA or historians at Levels 2 or 3 could eventually cause malfunction or disruption of physical processes and machinery at Levels 0 and 1. Furthermore, an adversary attempting to extract settings and configurations directly from Level 1 devices, such as PLCs, safety instrumented systems or RTUs, is at even higher risk of causing network disruptions or malfunctions, given the closer proximity and criticality of these devices to the physical processes being controlled by the OT network.

Five critical controls for OT cyber defence

To protect against these risks and related threats, the five critical controls for world-class OT cybersecurity identified by the SANS institute[2] are recommended. They present a framework for implementing a world-class OT cybersecurity program to defend against adversary activity directed against OT networks, be it IP theft, ransomware or targeted cyber-physical effects.

A first step in implementing these controls is achieving executive alignment on the role and importance of OT cybersecurity and the specific risks an OT cybersecurity program is meant to defend against. In this case, the risk of IP loss or OT network disruption as a result of adversary efforts to steal sensitive IP from an OT network. One potential way to achieve this organisational alignment is to tie the effort back to real-world scenarios and previous incidents. Research previous attacks and understand their relevance to your business. Extrapolate previous incidents into relevant scenarios that incorporate the unique aspects of your environment and capture how a similar loss of valuable IP or disruption would impact your company and its operations.

Conclusion

IT and OT networks are increasingly interconnected, a dynamic driven by diverse forces spanning from unprecedented global pandemics to support for broader digital transformations. This increasing interconnectivity continues to blur the boundaries between these two previously distinct network domains and has been accompanied by a spillover of threats more generally associated with IT into the OT network space.

IP theft through cyber means is no different, and increasingly robust protections for sensitive information in the enterprise IT realm can create a disparity in information availability and protection that could drive an adversary to pursue sensitive information from a company's OT network, which they are unable to access elsewhere.

Given that for many OT networks, valuable IP is hardcoded into the processes and operations the networks oversee, options for mitigating risk are somewhat circumscribed by this central reality. Accordingly, these network segments should be prioritised for incident response planning, increased visibility and robust monitoring.

1. Gelinne JP, Fancher D and Mossburg E 2016, 'The hidden costs of an IP breach: Cyber theft and the loss of intellectual property', Deloitte Review, Issue 19, Deloitte, ‹‹https://www2.deloitte.com/us/en/insights/deloitte-review/issue-19/loss-of-intellectual-property-ip-breach.html››
2. Lee RM and Conway T 2022, The Five ICS Cybersecurity Critical Controls, SANS Institute, ‹‹https://www.sans.org/white-papers/five-ics-cybersecurity-critical-controls/››

Dragos

www.dragos.com

COMPACT LASER POSITIONING SYSTEM

The AMS 100i from Leuze is a small laser positioning system designed for tight installations spaces.

Whether on the stacker crane, automated guided vehicle or lifting system, in automated intralogistics, the sensors used for positioning applications must be able to operate on a small footprint. With its small dimensions of 105 x 68 x 75 mm, the AMS 100i is said to be one of the most compact laser positioning systems on the market. The sensor also offers high accuracy, with millimetre accuracy for up to 120 m.

Leuze has developed the AMS 100i with a minimum blind zone of 100 mm. This enables positioning applications right up to the sensor. The available space is used efficiently, and modular assembly options and easy alignment facilitate flexible and quick installation.

The modular laser positioning system is also available in the AMS 300i version, offering an operating range of up to 300 m. Both variants meet the requirements of degree of protection IP65 and both the AMS 100i and the AMS 300i are also available with integrated device and window heating, which allows the sensors to be used for low-temperature applications down to -30°C (without heating down to -5°C). In hot ambient conditions, the AMS 100i is designed for temperatures of up to +60°C.

Leuze electronic Pty Ltd
www.leuze.com.au

ROTARY LOBE PUMP

The TORNADO T1 Generation F pump from NETZSCH Pumps is designed to produce high flow at low to medium pressures in a small compact package. It is suitable for applications in biogas and biomass plants, and can handle a wide range of viscosities, solids, temperature, abrasion, and corrosive/acidic process fluids and environments.

Its robust design offers longevity, operational flexibility and dry-run capabilities. It allows the pump to operate and handle many upset process conditions without causing harm to the pump. The pumps are available up to over 4000 gpm and up to 130 psi.

As a Full Service-in-Place (FSIP) pump, the front pullout design allows for easy access for maintenance and inspection. Opening the front cover allows access to the wear plates, lobes and seals, making the pump easy to service. Additionally, there is no need to access the timing gears or bearing as they are protected with the NETZSCH Gearbox Security System (GSS). This feature protects the gearbox from the process side of the pump (wet-end).

The GSS is an air gap that exists between the mechanical seal and the lip seal of the timing gearbox that establishes a physical separation between them. Should the mechanical seal leak, no product can get into the pump's gearbox to contaminate the timing gear oil. The air gap allows for the process fluid to drip away from the shaft and timing gearbox to prevent damage; the process fluid physically cannot pass through the air gap and migrate past the gearbox lip seal.

NETZSCH Australia Pty Ltd
pumps-systems.netzsch.com/en-AU

STRAIN GAUGE AMPLIFIER WITH UNIVERSAL INPUTS

The SIRIUSi-8xUNI is a strain gauge amplifier with universal signal inputs.

The Dewesoft SIRIUSi-8xUNI universal strain gauge amplifier adds an IEPE signal input to the already known STG amplifier. The module is based on SIRIUS DualCoreADC technology enabling a high dynamic range of >160 dB. The amplifier also offers a high voltage range (up to ±100 V) along with an improved excitation current accuracy. This enables constant current supply for quarter bridge applications (2- or 4-wire).

With the introduction of native IEPE mode, the SIRIUS UNI supports DC or AC mode input coupling with a 0.16 Hz high-pass filter for low ranges (0.3 Hz for 100 V range), and both Class 1 and Class 2 TEDS are supported. The input connector is D-SUB9; the optional connector is a female 10-pin LEMO 2B series (or 8-pin LEMO-2B or 16-pin LEMO-2B on request).

Metromatics Pty Ltd
www.metromatics.com.au

THERMAL CAMERA MODULES

Teledyne FLIR has announced the expansion of the Boson+ thermal camera module product line with 24 compact models featuring 320 x 256 resolution. Radiometry — the ability to take the temperature of every pixel — as well as both MIPI and CMOS interfaces is now also available on all resolutions. With these updates and a thermal sensitivity of 20 mK or less, the product is suitable for integration in unmanned ground vehicles (UGV), unmanned aircraft systems (UAS), automotive, wearables, security applications, handhelds and thermal sights.

Boson+ is a drop-in upgrade for systems designed with Boson, making upgrades low risk and plug-and-play. With user-selectable USB, CMOS or MIPI video interfaces, it is easy to integrate Boson+ with a wide range of embedded processors.

The product range features 640 x 512 and now 320 x 256 resolutions utilising a 12 μm pixel pitch thermal detector within a size, weight and power (SWaP) optimised package. The noise equivalent differential temperature (NEDT) of 20 mK or less offers enhanced detection, recognition and identification (DRI) performance, especially in low-contrast and low-visibility environments. With improved automatic gain control (AGC) and video latency compared to previous iterations of Boson, the product is said to offer enhanced scene contrast and sharpness while improving tracking, seeker performance and decision support.

Teledyne FLIR
www.flir.com.au

PANEL PC

The Aplex HELIO-910CP is a 10.1″ fanless industrial panel PC with 11th-generation Intel Tiger Lake Core i3 and i5 processors. Designed for use in a wide range of environments, the product offers several customisation options, including optional high-brightness 1000 nits sunlight-readable screens, optional AG/AR coating, optical bonding and automated dimming.

The device features a flat front-panel touch screen with an IP66 front bezel and a fanless design that makes it suitable for rugged applications, such as industrial and factory automation and in hazardous areas. With two DDR4 slots that support up to 64 GB memory, a projected capacitive touch screen and an aluminium chassis, the unit provides a compact and durable solution for industrial applications.

Additional features include wall mounting or VESA mounting and Windows 10 IoT Enterprise support. The device also supports TPM2.0 hardware security, and expansion via full-size mini-PCIe and M.2 slots.

Multiple internet connectivity technologies are supported, such as Wi-Fi 6, 5G, LTE, Bluetooth and Gigabit LAN. It also offers an optional backup battery for extended remote working and controlled shutdown. The device has a standard operating temperature range of 0 to 50°C, and optional wide-temperature (-20 to 60°C) versions are available.

Backplane Systems Technology Pty Ltd
www.backplane.com.au

THERMAL IMAGING MOBILE CAMERA

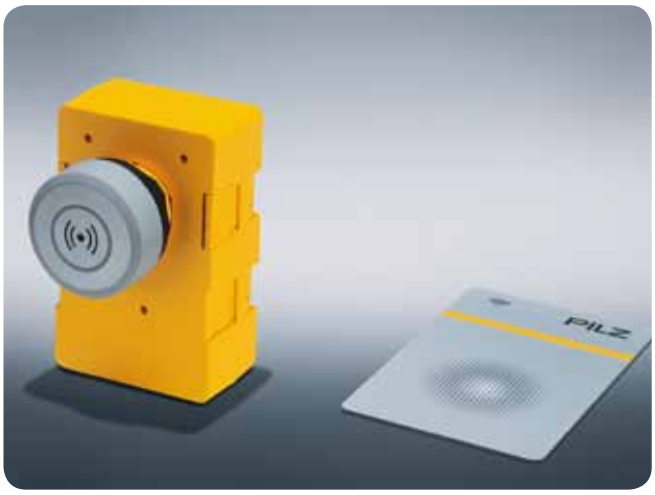
Slentech is offering the S1 smart thermal imaging mobile camera from SATIR as a part of a new development to make thermal imaging smart and handy. It has an open Android platform making it an easy-to-use device to suit all levels of thermal imaging users.

It has a 256x192 IR detector that can deliver 49,152 pixels to the end-user's screen. This multifunctional device also features a 48 MP digital camera with 8 MP depth of field, which also supports photo, video, panoramic photo, auto-focus, auto-flash, HDK and continuous shooting. Storage is available for videos and images up to 256 GB.

It has a measuring temperature range of -20 to + 550°C, with a measurement accuracy of ±2 or ±2% of readings.

Other key features of this thermal camera include a screen display size of 6.57″ FHD+ (20:9 full screen) with 2520 x 1080 resolution, a built-in battery capacity of 5000–5500 mAh (supporting fast charge QC4.0), an image storage function (SIM Type-2 nano cards), an encapsulated IP68 body, 5G and 4G data connection, fingerprint reader, GPS support, Wi-Fi and Bluetooth.

Slentech Pty Ltd
www.slentech.com.au



ACCESS PERMISSIONS VIA CARDS AND STICKERS

The RFID-capable PITreader card and stickers can be used in conjunction with the existing PITreader transponder key, or as its replacement. Machine operators have their permissions on the transponder and use them to authenticate themselves on the PITreader card unit, to gain entry to a plant or machine. This gives companies increased industrial security because they control who has what permission and therefore who is granted access to the process. With the additional transponder types, there is greater flexibility in managing access permissions.

The RFID transponders are available in both freely writeable and preconfigured versions. Users can still read the LED status indication on the access authorisation system even when the PITreader card is held up to it, due to the transparent window on the card. If the company already uses RFID-capable cards, these can also be used with the PITreader card device so that users only need one card for multiple functions.

Pilz is also releasing a version of the PITreader S card device that incorporates the OPC UA standard, providing the highest level of safety and communication.

The graphical user interface on the associated software solution PIT Transponder Manager (PTM) allows administrators to manage settings, block lists and user data for the transponder keys, cards or stickers. Individual user rights can be quickly and easily written to the RFID transponder using predefined templates. The administrator can save time by using the import function to read information rapidly and directly into the integrated database.

Pilz Australia Industrial Automation LP
www.pilz.com.au

This issue is sponsored by — **Moore Industries** — www.miinet.com/safetyseries

SMART FIREWALL FOR DCS

Emerson has announced it is improving perimeter security for the DeltaV distributed control system (DCS) with its NextGen Smart Firewall, a purpose-built control system firewall that it says is designed to provide easy-to-install and easy-to-maintain perimeter security for all industries. More ruggedised construction, increased bandwidth and role-based access provide users with increased performance and more granular access control.

Emerson said its NextGen Smart Firewall features a user-friendly HTML5 web-based user interface, easy-to-understand setup menus and predefined DeltaV application rules. The ease of use helps DeltaV administrators and control engineers with no security or IT expertise to create secure connections for DeltaV applications.

Emerson's NextGen Smart Firewall features include virtual private networks (VPNs) to increase flexibility and security for geographically dispersed networks, network address translation (NAT) to protect network IP schemes and conserve addresses, and more granular user roles, so that administrators have full control, engineers may add or modify application rules and auditors have read-only access to logs.

Emerson Automation Solutions

www.emerson.com/au/automation

MINIATURISED AXIAL GEARBOX

The miniaturised Galaxie gearbox from Wittenstein is a high-precision gearbox with axial power transmission that is said to offer true zero backlash throughout its entire lifetime. These characteristics are suitable for applications in medical and precision robotics, semiconductor and wafer handling systems or high-end machine tools.

Power transmission in the gearbox is axial, not radial. The single teeth in the tooth carrier, which are arranged in a gear ring, are axially driven by a polygonal disc with two high points into the flat wheel with special helical crown gearing, similar to a screwing movement. This axial kinematic is responsible for the compact outer dimensions of the Galaxie in the standard sizes typically encountered in robotics applications.

The teeth of the miniaturised Galaxie gearbox are fundamental to the axial function principle. They are designed as so-called 'crown' teeth, in other words they have more flanks per tooth and thus more flank surface, enabling almost complete surface contact when in mesh — in contrast to strain wave gearboxes with linear contact. In addition, the movement of the polygonal disc in the Galaxie means the majority of the crown teeth constantly contribute to torque transmission and torsional rigidity. The crown tooth concept also allows the gearbox to achieve ratios of i=60/61, which is a key performance requirement in robotics applications.

The entire Galaxie range ships in sizes from 90 to 300 mm outer diameter with maximum acceleration torques from 150 to over 7500 Nm.

Treotham Automation Pty Ltd
www.treotham.com.au

INFRARED TEMPERATURE SENSING MODULE

The ICP DAS iSN-812-MTCP infrared temperature sensing module can be used for non-contact temperature measurement in a variety of fields. The device provides a wide range of temperature pixels and temperature threshold detection functions to meet various temperature measurement needs. It has a temperature measurement range of -40 to 300°C and a field of view (FOV) of 110° x 75°.

One of the features of iSN-812-MTCP is its support for PoE IEEE 802.3af class1, which allows it to transmit data using the Modbus TCP protocol through a PoE switch while receiving power from it.

The iSN-812-MTCP is compatible with the VPD-1xx-IRT series temperature data concentrator, which collects temperature data from the module and integrates it into a SCADA system via Modbus TCP. This enables real-time monitoring and reporting of temperature data.

ICP Electronics Australia Pty Ltd
www.icp-australia.com.au

DC-DC CONVERTERS

The RHINO Pro DC-to-DC converters are designed for harsh industrial environments and feature stringent protection ratings. They provide high EMC immunity against surge, burst, radiated and conducted disturbances as well as shock and vibration resistance plus thermal shock resistance.

The PSRP series of industrial DC-to-DC converters offer a wide operating temperature range of -40 to +75°C. These units accept a variety of DC inputs and convert them to the required voltage levels with up to 150 W of output power. They are fully encapsulated in an aluminium housing and offer easy chassis and wall mounting.

The line offers models with outputs at 12, 15, 24, or 48 VDC, and ultra-wide input voltage ranges of 9–36 VDC or 18–75 VDC. They provide protection against overtemperature, overload, short circuit, reverse input, overvoltage and input undervoltage lock-out, and deliver a constant current output at 100% load, making them suitable for battery charging applications.

Direct Automation Pty Ltd
www.directautomation.com.au

This issue is sponsored by — **Moore Industries** — www.miinet.com/safetyseries

AI COMPUTING SYSTEM

Advantech has released the MIC-733-AO, an NVIDIA Jetson AGX Orin-based AI computing system. Designed for the growing trend for Video+AI+5G applications, the MIC-733-AO features high computing power, flexible video input support and wireless communication. With 24/7 remote management support, MIC-733-AO is an industrial edge AI computing system designed for AMR/AGV applications.

The MIC-733-AO is a compact fanless system capable of enduring wide operating temperatures (-10 to 60°C) found in outdoor and harsh environments. It delivers a flexible array of expansion slots and multiple I/O ports, including four USB 3.2 ports, two Mini-PCIe ports and two M.2 ports. Additionally, it offers iDoor and iModule expansion and support for diverse peripherals. There is also I/O module customisation available through the Mini-PCIe and full PCIe interfaces.

The MIC-733-AO is aimed at helping developers with high-performance AI applications at the edge, large-scale deployments and data security during implementation. Advantech collaborates with Allxon to provide a 24/7 remote management service on the NVIDIA Jetson edge AI and robotics platform, enabling large-scale deployment and device management through over-the-air (OTA) and out-of-band (OOB) service. MIC-733-AO is also Azure IoT certified with the Microsoft reference configuration. In addition, the Azure Edge Managed Program, Microsoft Defender for IoT, provides threat detection for the device's operating system and applications.

Advantech Australia Pty Ltd
www.advantech.net.au

PHOTOELECTRIC SENSORS FOR HYGIENIC ENVIRONMENTS

When packaging or filling foodstuffs or pharmaceuticals, the highest requirements apply to hygiene and the cleaning of the system. The 53C/55C series photoelectric sensors from Leuze have been developed to be suitable for hygiene-sensitive production and packaging processes. The housing is made of high-quality, smooth V4A stainless steel and a glass-free, scratch-resistant optics cover. The sensors can therefore withstand demanding cleaning, disinfection cycles and large temperature fluctuations.

The 53C/55C series sensors come in the form of through-beam photoelectric sensors, retro-reflective photoelectric sensors or diffuse sensors. Depending on the model, Leuze solutions can detect glass, PET, film or small parts. The fill level of aqueous liquids can also be detected. The 53C/55C sensor series are dust-proof and waterproof, and meet the requirements of protection classes IP67/IP68 and IP69K. The sensors can be configured, operated and maintained via IO-Link.

For wet areas, Leuze has developed the 55C series in a gap-free and washdown design. Optics and operational controls are made of non-diffusive and chemically stable materials.

The sensors of the 53C series have a hygienic design: the housing is consistently designed to prevent bacterial contamination. Smooth contours without fastening holes prevent deposits, and the sensor and machine have a gas-tight connection via the mounting trunnion. The 53C series is suitable for particularly hygiene-sensitive areas, such as direct contact with food or for installation above unpackaged products.

Leuze electronic Pty Ltd
www.leuze.com.au

Leader in Low Flow Fluidics Handling Technology

- Flow ranges for gases from 0 - 0,7 ml_n/min up to 0 - 11000 m^3_n/h
- Flow ranges for liquids from 0 - 100 mg/h up to 0-600 kg/h
- Pressure ranges from 0 - 100 mbar up to 0 - 400 bar
- Laboratory, industrial (IP65), Class I Div. 2 or ATEX approved design
- Analog, RS232, FLOW-BUS, PROFIBUS DP, PROFINET, DeviceNet™, Modbus, EtherCAT®

Bronkhorst®

www.bronkhorst.com - www.ams-ic.com.au

AMS

ROBOTS: THERE'S ONE FOR EVERY JOB

PART 1

Kevin Tardif, Business Development Specialist – Electric Automation, Festo Inc.

The proliferation of robot technologies has enabled businesses of all sizes to access the benefits of automation — but which type is best?

This issue is sponsored by — **Moore Industries** — www.miinet.com/safetyseries

The first industrial robot was installed at a General Motors factory in New Jersey in 1961. In 1969, the Stanford Arm with six degrees of freedom was developed, making robots suitable for an extraordinary range of tasks.

For a half century now, robots have been the centrepiece of Industry 3.0, which is typically defined as the age of pre-digital automation. They will be just as critical if not more so as the world transitions to Industry 4.0, the digital automation age. Robots have been changing the industrial landscape since their introduction in the 1970s; they represented a quantum leap in productivity, flexibility and reliability. Almost any repetitive motion involving the movement of an object — be it tooling like a welding gun or sheet metal being welded — can be done faster and with greater precision and repeatability by a robot.

Early on, the image of the large, six-axis articulated robot welding car and truck bodies became fixed in the popular imagination. Articulated robots have spread throughout and beyond heavy industry with many improvements to the robot itself as well as the development of more end effectors to address the wider need for flexible automation. Articulated robots are used in sectors as diverse as health care, food and beverage, steelmaking, warehousing — wherever there are repetitive or environmentally or ergonomically challenging tasks that can be accomplished faster, more reliably or more cost-effectively. Robots are even assembling new robots.

Today, robots are easier than ever to integrate into any manufacturing or processing environment, including food zones, cleanrooms and warehouses. All that said, given this plethora of options, it's more important than ever to know which type of robot best fits a company's needs from both a capabilities and cost standpoint. The major types of robots — articulated, Cartesian, SCARA, delta and cobot — each have strengths and limitations. Understanding these pros and cons is a necessary starting point for making an initial investment in robotics.

iStockphoto.com/anon-tae

This issue is sponsored by — **Moore Industries** — www.miinet.com/safetyseries

New concepts in robotics

Initially, the robot revolution provided major manufacturers like automakers with even greater economies of scale, but offered nothing to most small and medium-sized businesses. Developments in Cartesian robotics (linear), SCARA and delta robots to name the most widely used — as well the newest commercial innovation, collaborative robots — have made automation accessible to businesses of almost any size.

Each type of robot comes with benefits and limitations. For would-be new adopters of robotics, it's important to understand those possibilities and pitfalls.

Robots come with 1–7 axes, each axis providing a degree of freedom. A two-axis Cartesian gantry typically plots on the X-Y or Y-Z axes. A three-axis robot has three degrees of freedom and performs its functions through the X-Y-Z axes. These small robots are rigid in form and cannot tilt or rotate themselves, although they can have attached tooling that can swivel or rotate or adapt to the shape of a small payload. Four- and five-axis robots have additional flexibility to rotate and tilt. A six-axis articulated robot has six degrees of freedom — the flexibility to move objects in any direction or rotate them in any orientation. The latter type is generally chosen when an application requires complex manipulation of objects. The seventh axis allows extended reach in one axis; in other words, it allows displacement of the six-axis articulated robots.

Seven-axis robots are likewise fully free; the seventh axis can allow additional orientations to manoeuvre tooling in tight spaces. For example, such a robot can weld a car body frame from the inside of the cabin by inserting the end effector through the window opening and rotating it backwards 180 degrees. Seven-axis robots can operate up closer to the work piece than other articulated robots for potential space savings.

Articulated robots: benefits and limitations

The popularity of six- and seven-axis articulated robots reflects the great flexibility that six degrees of freedom permit. They are easy to program, come with their own controller, and movement sequences and I/O activation can be programmed via a user-friendly teach pendant. In most applications, only a basic knowledge of programming is required to activate the robot. On the hardware side, industrial articulated robots can be relatively small or massive (capable of handling loads like locomotive wheelsets weighing over a ton). They can have substantial reach, over three metres with certain models. This range of sizes makes articulated robots suitable for a great number of industries and applications involving making or moving of materials or finished goods.

The articulated robot also has issues which can restrict its utility or boost its cost profile. A small-sized articulated robot is easy to install; its base only need be bolted to a frame or floor. But it can only lift so much or reach so far. Where the job requires a larger robot, civil engineering may be required to ensure the structure can handle the weight and torque caused by the load offset. An articulated robot grows in reach and payload simultaneously. The longer the reach, the greater the payload it can manage, the more space and engineering it requires, the more it costs. Where an application involves handling a small load over a long reach or a heavy load over short distances, an articulated robot may not be the most cost-effective solution.

By design, the articulated robot occupies space and footprint that can't be utilised for other purposes. It also has singularities, ie, locations and orientations in the surrounding space it cannot access.

These spatial limitations require more complex safety precautions since the robot will often be used in zones where workers are present, even just occasionally. Expensive devices such as zone scanners or safety mats are often necessary, and more advanced functionalities are then required, such as Safety-Limited Speed (SLS) or Safe Speed Monitor (SSM). The fact it requires its own controller to handle the inverse kinematics (the conversion of the multiple motor rotary positions to usable Cartesian coordinates and orientation in space) can also represent a double dip from a hardware perspective, since in certain cases the robot controller will need to communicate with a higher-level PLC on the production line. The bottom line is an issue as well. Where the full flexibility of a six-axis robot is not required, like many pick-and-place or packaging applications, other types of robots may do the job just as well if not better, and at a lower cost.

Cartesian robots: benefits and limitations

One of those lower-cost alternatives is the Cartesian or linear robot. Its design consists of an assembly of linear actuators and sometimes a rotary actuator at the end of an arm for 3D applications. It's easy to install and maintain. The Cartesian robot is fully adaptable; strokes and sizes of each axis can be customised to the application. Its reach and payload are independent of each other, not intertwined. The linear axis comes in a number of designs which further adapt it to the function it performs. For example,

This issue is sponsored by — **Moore Industries** — www.miinet.com/safetyseries

> TODAY, ROBOTS ARE EASIER THAN EVER TO INTEGRATE INTO ANY MANUFACTURING OR PROCESSING ENVIRONMENT, INCLUDING FOOD ZONES, CLEAN ROOMS AND WAREHOUSES.

iStockphoto.com/anon-tae

toothed belt actuators allow high velocities while ball screw actuators permit high precision and high feed force, with pick rates up to 100/min fairly typical of this type.

The adaptability of these handling systems makes them price-optimised for a wide range of straightforward applications where the dexterity of an articulated robot isn't required. That can involve extremely light to very heavy parts placement, sorting or box-loading, device inspection and much more. Another major advantage and differentiator of the Cartesian robot is its excellent space economy. It allows full access to the footprint it occupies. There is no dead space or singularities. Safety requirements are less stringent and hence less costly since the robot's reach is limited to its small working zone. Fences, door switches or light curtains are often sufficient to ensure proper safety. Little space around the robot is wasted.

Programming the Cartesian robot doesn't usually require a specific motion controller. Since the actuators are moving along the workspace coordinate system axis, interpolation of the motor's position is not mandatory to determine the robot end-of-arm position in space. In other words, no calculation of inverse kinematics is needed. The system PLC can often be used to control each axis directly, without the addition of a second controller. Also, Cartesian robot designs are readily scalable, and are more often than not composed entirely of standard, catalogue components from servo drives/motors and controller to slides and grippers. That's part of their affordability and assures replacement parts are readily available and quickly installed.

The Cartesian robot's main limitation is comparative inflexibility. It will easily accommodate linear movement in three axes and a forth, rotative axis. However, one has to add a motion controller to perform more complex synchronised tasks, such as CNC. Cartesian robots are rarely used in washdown environments; they don't provide sufficient protection against water ingress. Precision and thoroughness at installation is required. Each axis must be carefully aligned and surface flatness must be adequate, especially in larger systems. Cartesian robots are also configured uniquely for each application. While product or packaging format changes can be performed quickly via the PLC, mechanical modifications of the unit may be required for more extensive changes in the application. Finally, Cartesian robots, if used without a separate motion controller, may require more programming time than other robot types. Teach pendants are less common, so programming of sequences must be done in the PLC, with each axis addressed and commissioned individually.

In Part 2

In Part 2 of this article, SCARA and delta robots — and the newest type, cobots — will be discussed, before looking at the considerations necessary in choosing the right type for your application.

Festo Pty Ltd

www.festo.com.au

CLEANROOM-RATED STATIC ELIMINATORS

EXAIR's Intellistat Ion Air Gun and Ion Air Nozzle are useful for static elimination in clean processes or sensitive assembly work such as scientific and electronic test facilities, laboratories and clean rooms. They are designed to consume minimal compressed air while delivering blow-off and high static decay rates capable of reducing 1000 V to less than 100 in 0.6 s at up to 610 mm away. They also provide a lightweight solution rated Class 5 for cleanrooms and controlled environments per ISO 14644-1.

The Intellistat Ion Air Nozzle comes equipped with a mounting bracket to assist with remote mounting or benchtop assembly for hands-free use. It neutralises static in sensitive processes like scientific and electronic testing, cleaning medical or pharmaceutical products and packaging, or removing debris from sensitive electronics.

The handheld Intellistat Ion Air Gun is lightweight and activated with an ergonomic short throw trigger that is designed to require minimal effort. It produces clean, ionised compressed air essential for removing dust, static or particulate contaminants in sterile environments.

Intellistat products' design hosts an efficient, low-voltage transformer converting 120 V to 24 V for user safety, while also utilising an EXAIR-engineered air nozzle to maximise efficiency and meet OSHA requirements for sound level and dead-end pressure. They are equipped with a red/green LED to signify proper functionality. Their static dissipative polycarbonate construction makes them suitable for applications requiring non-conductivity such as circuit board or electronics manufacturing or testing.

The EXAIR line of Intellistat products is UL listed and CE compliant.

Compressed Air Australia Pty Ltd
www.caasafety.com.au

COMPRESSORS

ELGi Equipments has enhanced the energy efficiency of its AB series oil-free screw air compressors realising improvements in specific power consumption and increases in free air delivery across the range.

Improvements in the AB series include an average 10% improvement on the turn down ratio across the variable frequency drive (VFD) range.

The series is available in power ratings from 11 to 110 kW, and the 75 to 110 kW models are the first in the series to now come as standard with super-premium efficiency IE4 motors, which exceed the current Minimum Energy Performance Standards (MEPS) of Australia and New Zealand for three-phase electric motors. Using these motors provides further energy efficiency and reliability gains as well as lower waste heat output.

ELGi's airends are equipped with in-house developed η-V profile rotors which reduce pressure losses and precise rotor clearances. Compared to other water-injected units, the AB series airends run at slow speeds, resulting in longer bearing life, higher reliability and lower noise levels.

The AB series has a closed loop circuit which does not need RO water or any other form of water purifying system. They also come with an auto water replenishment mechanism, as well as built-in sensation cycle. This reduces power consumption, eliminates any requirement to replace an RO element which therefore reduces maintenance costs.

Elgi Equipments Ltd
www.elgi.com.au

DIFFERENTIAL PRESSURE TRANSMITTER

Dwyer has released the Series IDPT industrial differential pressure transmitter. The transmitters feature a rugged, water-resistant housing and stable accuracy for a long service life in most industrial applications, including semiconductors, pharmaceuticals, laboratories, fume hoods, HVAC pressure, critical measurement and high-purity applications.

This pressure transmitter utilises a capacitive pressure sensor on ranges 0–0.25″ H_2O to 0–1″ H_2O and a piezoelectric sensor for ranges 0–2.5″ H_2O to 0–10″ H_2O, both of which offer accuracy options of 0.25% or 0.5% of full scale. The capacitive cell allows the IDPT to maintain critical processes in industrial applications. The series offers a 4–20 mA 2-wire version for a loop-powered current output as well as a 0–5 VDC or 0–10 VDC selectable voltage output version.

Dwyer Instruments (Aust) Pty Ltd
www.dwyer-inst.com.au

This issue is sponsored by — **Moore Industries** — www.miinet.com/safetyseries

Automated threat detection improves OT cybersecurity

A South-East Asian oil and gas industry firm's security, engineering and executive personnel all recognised that preserving the availability, integrity and safety of its hydrocarbon production operations required a robust operational technology (OT) cybersecurity program. However, the company's head of OT cyber operations also knew it would not be possible to achieve this alone.

Like most critical industrial organisations, the company had historically struggled to maintain a comprehensive, up-to-date inventory of the diverse range of assets that underpin operations at each of its plants and production sites. This meant the company's security and engineering personnel were limited in their ability to not only identify and mitigate vulnerabilities affecting industrial assets, but also to monitor for and respond to threats to its hydrocarbon production operations.

The OT cyber operations head recommended the company deploy a cybersecurity solution capable of delivering the visibility, risk management and monitoring capabilities required to protect the company's entire OT environment. The chosen solution would need to satisfy the following key criteria:

The chosen solution would need to provide comprehensive asset and risk visibility, enable centralised management and actionable reporting, and be powered by OT purpose-built technology.

After consulting with industry experts and rigorously evaluating multiple options based on the above criteria, the firm selected Claroty's Continuous Threat Detection (CTD) solution to bring visibility and security to its more than 100 industrial sites.

Before deploying Claroty CTD, the company had handled asset inventory the old-fashioned way: with spreadsheets. Personnel not only had to manually account for each asset at each site, but they also had to manually visit each asset's vendor's website, look up whether any new vulnerability disclosures or other advisories had been published, determine which advisories were relevant and then decide which actions were warranted. The tedious, time-consuming nature of this process meant it was only undertaken every 8–10 years. In the intervening years, their asset inventory would become increasingly inaccurate and the risk of blind spots became increasingly prevalent as more assets were added and more vulnerabilities went unaddressed.

Since deploying Claroty CTD, with fully automated asset discovery and vulnerability correlation, the company has gained full, real-time visibility into all of its assets and all relevant vulnerabilities without the need for time-consuming site visits, error-prone manual processes or unwieldy spreadsheets.

"Our engineers don't have to manually make and maintain that asset inventory anymore," said the Head of OT Cyber Operations. "Everything is retrievable online, and we have the latest version from the asset inventory perspective. That's very useful for day-to-day operations."

Beyond granting full visibility into the OT environment, Claroty CTD has also helped synergise the long-siloed (and often geographically disparate) security, engineering and executive functions supporting the company's hydrocarbon production operations at its more than 100 sites. By serving as the single source of truth for all asset, system, process and risk information, the system now ensures such information is accessible, consistent and actionable to all personnel, workflows and decisions that depend on it.

One example shared by the company is the receiving of and responding to alerts specific to the complexities of industrial networks, such as when a given process goes beyond established parameters after an update or configuration change. Another is the ability to pinpoint unusual activities in real time before potential damage occurs, such as an attempt to "access an asset via remote desktop protocol (RDP) at night when we don't usually work and maintenance windows aren't usually scheduled".

The tool also gives granular risk scoring to understand and prioritise the order and extent to which vulnerabilities should be remediated or otherwise compensated for.

"The insights CTD provides often save me from having to get in touch with a device's vendor to look into issues," said the Head of OT Cyber Operations. "More often than not, all the details I need to understand what's going on and what to do are right there in the system. This translates to considerable operational cost savings due to a lowered reliance on third-party vendors for troubleshooting and drastically reduced mean-time-to-respond overall."

Claroty CTD's adaptability, ease of deployment and non-proprietary hardware requirements were among many reasons why it was selected as the solution initially. Due to the use of non-disruptive sensors, Claroty CTD is designed such that the industrial asset inventory and monitoring scope can scale to support new or expanded production sites as the company — and its OT environment — grow and evolve over time.

"Having this solution means that I can clearly see everything from the asset perspective, what changes have been done to particular networks or equipment over time and — most importantly — where my biggest gaps are in terms of security," he concluded.

Claroty

www.claroty.com

VISION SENSOR

The IVS 1048i vision sensor can perform counting and measuring tasks in addition to presence detection. Users can choose between six models with two different resolutions. Depending on the model, the functions of the IVS 1048i range from object detection and measuring tasks to integrated barcode reading.

If just codes are to be read, the DCR 1048i sensor is available as an alternative. Advantages of all IVS/DCR 1048i sensors include four interchangeable S-Mount lenses with variable focus adjustment and two apertures to provide a high degree of flexibility in terms of reading distance, field of vision, resolution and depth of field. Interfaces for digital I/O supporting TCP/IP, Profinet, FTP and SFTP are integrated.

Leuze electronic Pty Ltd
www.leuze.com.au

TOUCHSCREEN MONITORS

ADLINK Technology has introduced its OM and IM Series touchscreen monitors. The open-frame (OM) and true-flat (IM) monitors feature a slim design and smooth user interaction suitable for HMI applications in a wide range of industries including smart manufacturing.

The monitors have a wide viewing angle feature for outdoor or semi-outdoor use and anti-fingerprint surface treatment to help ensure clear visibility under sunlight. Additionally, support for Projected Capacitive (PCAP) 10-point multi-touch enables a smooth user experience. These high-durability monitors are equipped with industrial-grade panels, protected by 7H hardness and IP65-rated front panels to withstand long hours of operating in harsh environments.

The OM series (open-frame) has a wide range of panel sizes (from 10.1″ to 43.0″) and is designed for use in embedded display applications. The panels are easily integrated with a variety of systems and applications.

The IM series (true-flat) is a standalone industrial touch monitor that supports a variety of mounting options (wall mount, VESA and desktop stand), with a plug-in and ready-to-use design enabling applications in many fields.

ADLINK Technology Inc
www.adlinktech.com

ETHERNET SWITCH WITH PoE

The ICP DAS NSM-205PFT-24V is an Ethernet switch with Power-over-Ethernet (PoE) capability suitable for industrial networking applications. It features four 10/100 Mbps Ethernet ports with PoE functionality and a 100base-FX fibre port with a multi-mode ST connector. Each Ethernet port can negotiate speed up to 100 Mbps automatically, and the switch has a store-and-forward architecture. Additionally, the switch supports full-duplex IEEE 802.3x and half-duplex backpressure flow control to prevent data loss and optimise network performance.

The NSM-205PFT-24V also supports automatic MDI/MDI-X crossover, which allows plug-and-play installation without the need for any additional configuration. The switch automatically detects powered devices (PD) and provides power management accordingly. It also has over-temperature, over-current and over/under-voltage detection for safety and stability.

The switch is designed to operate in harsh environments, with an operating temperature range of -30°C to 75°C. It also supports DIN-rail mounting for easy installation.

ICP Electronics Australia Pty Ltd
www.icp-australia.com.au

This issue is sponsored by — **Moore Industries** — www.miinet.com/safetyseries

ULTRASONIC WATER METER WITH WATERMARK CERTIFICATION

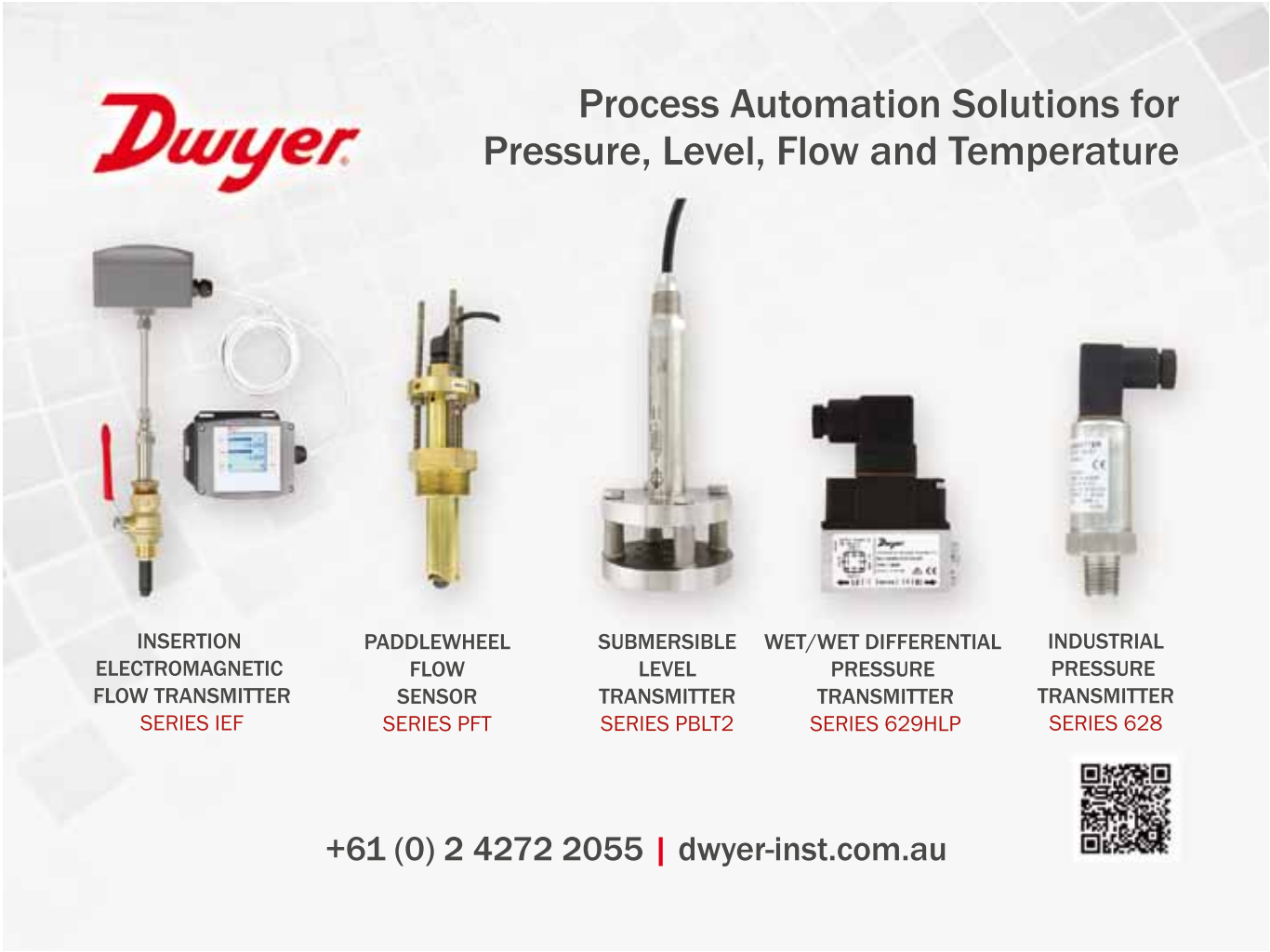
AMS Water Metering has announced that it has achieved WaterMark certification for the Qalcosonic W1 Australian Utility Version smart ultrasonic water meter.

Along with the NMI R49 metrology approval, AS3565.1 water meter approval and AS4020 drinking water approval, the WaterMark approval now means that the meter is fully certified for supply into the Australian water utility market.

The Qalcosonic W1 Australian Utility Version is assembled in the Melbourne facility of AMS Water Metering using the Qalcosonic W1 smart ultrasonic water meter manufactured by Axioma Metering in Lithuania. AMS Water Metering fits brass threaded adapters, a dual check valve and copper conducting strip to the Qalcosonic W1 to produce the Australian Utility Version which meets the requirements of the Australian water utility market for end-to-end length, dual check valves and electrical conductivity.

The Qalcosonic W1 is a compact, fully integrated smart ultrasonic water meter with a one-piece moulded composite plastic body with an IP68 rating. The ultrasonic measuring technology has no moving parts and maintains high accuracy throughout the life of the meter. It is available with fully integrated LoRaWAN or NBIoT communication protocols and the battery life is up to 16 years. The LoRaWAN version has RCM approval, while the NBIoT version will shortly have RCM approval.

AMS Water Metering
amswatermetering.com



iStock.com/Photodisotroff

An automated way to assemble thousands of objects

The manufacturing industry (largely) welcomed artificial intelligence with open arms. However, planning for mechanical assemblies still requires more than scratching out some sketches — it's a complex conundrum that means dealing with arbitrary 3D shapes and highly constrained motion required for real-world assemblies.

Human engineers need to manually design assembly plans and instructions before sending the parts to assembly lines, and this manual nature translates to high labour costs and the potential for error.

In a quest to ease some of these burdens, researchers from MIT's Computer Science and Artificial Intelligence Laboratory (CSAIL), Autodesk Research and Texas A&M University came up with a method to automatically assemble products that's accurate, efficient and generalisable to a wide range of complex real-world assemblies.

The team created up a Spartan-level large-scale dataset with thousands of physically valid industrial assemblies and motions to test their method. The proposed method is capable of solving almost all of them, especially outperforming previous methods by a large margin on rotational assemblies, like screws and puzzles. It can solve 80-part assemblies within several minutes.

"Instead of one assembly line specifically designed for one specific product, if we can automatically figure out ways to sequence and move, we can use a fully adaptive setup," said Yunsheng Tian, a PhD student at MIT CSAIL and lead author on the paper. "Maybe one assembly line can be used for tons of different products. We think of this as low-volume, high-mixed assembly, as opposed to traditional high-volume, low-mixed assembly, which is very specific to a certain product."

Given the objective of assembling a screw attached to a rod, for example, the algorithm would find the assembly strategy through two stages: disassembly and assembly. The disassembly planning algorithm searches for a collision-free path to disassemble the screw from the rod. Using physics-based simulation, the algorithm applies different forces to the screw and observes the movement. As a result, a torque rotating along the rod's central axis moves the screw to the end of the rod, then a straight force pointing away from the rod separates the screw and the rod. In the assembly stage, the algorithm reverses the disassembly path to get an assembly solution from individual parts.

Currently in a factory or assembly line everything is typically hard-coded. To assemble a given product, you have to precisely program instructions to assemble it. Which part should be assembled first? Which part should be assembled next? And how are you going to assemble this?

Previous attempts have been mostly limited to simple assembly paths, like a very straight translation of parts — nothing too complicated. To move beyond this, the team used a physics-based simulator — a tool commonly used to train robots and self-driving cars — to guide the search for assembly paths, which makes things much easier and more generalisable.

"Let's say you want to disassemble a washer from the shaft, which is very tightly geometrically assembled. The status quo would simply try to sample a bunch of different ways to separate them, and it's very possible you can't create a simple path that's perfectly collision-free," Tian said. "Using physics, you don't have this limitation. You can try, for example, adding a simple downward force, and the simulator will find the correct motion to disassemble the washer from the shaft."

One avenue of work the team is looking to explore is making a physical robotic setup to assemble items. This would require more work in terms of robotic control and planning to be integrated with the team's system, as a step towards their broader goal: to make an assembly line that can adaptively assemble everything without humans.

"The long-term vision here is, how do you take any object in the world and be able to either put that together from the parts, using automation and robotics?" Willis said. "Inversely, how do we take any object in the world that's made up of many different types of materials and pull it apart so that we can recycle and get them into the correct waste streams? The step we're taking is looking at how we can use some advanced simulation to be able to begin to pull apart those parts, and eventually get to the point where we can test that in the real world."

A longer and more detailed version of this story can be found at https://bit.ly/43tvdAf.

This issue is sponsored by — **Moore Industries** — www.miinet.com/safetyseries

EDGE AI COMPUTER

Backplane Systems Technology has released the Neousys Nuvo-9160GC Series edge AI computer that uses NVIDIA's 130 W RTX GPU card with Intel's 12th Gen platform to give greater CPU and GPU performance.

Intel's 12th Gen processors can offer up to 16 cores/24 threads with 1.8 times the performance gain over prior Intel 11th/10th Gen platforms. For real-time AI inference applications using numerous cameras, such as production line vision inspection, intelligent video analytics for surveillance or ITS, or autonomous mobile robots, the most recent NVIDIA 130 W RTX GPU provides over 9 TFLOPS of FP32 performance (AMR).

The thermal design of the Nuvo-9160GC is designed to support system operation from -25 to 60°C. It has an isolated ventilation design for the 130 W GPU card inside Neousys's expansion Cassette, as well as passive cooling for the motherboard. The Nuvo-9160GC supports six GigE cameras (or IP cameras) and six USB 3 cameras. Additionally, it offers a variety of data storage options, including two 2.5″ SATA HDD/SSD drives to increase storage space and one M.2 2280 Gen4x4 NVMe drive with read/write rates of up to 7000 MBps.

Backplane Systems Technology Pty Ltd
www.backplane.com.au

TURCK
Your Global Automation Partner

Sustainable Automation

Efficient production, effective energy management and transparent supply chains. Digital automation solutions guarantee profitability and sustainability at the same time!

LEARN MORE
www.turck.com/wes

AI IN INDUSTRIAL AUTOMATION: FROM CHATBOTS TO PLANT CHUMS AND HALLUCINATIONS

With the current hype around AI, its impact on instrumentation, control and industrial automation must be considered. Software companies that reference it are certainly enjoying an upward blip in share price; but is it really that useful?

Essentially, the AI algorithm is based on a vast repository of content extracted from the web and underpinned by computing power.

In November 2022, OpenAI announced the Large Language Model (LLM) and associated ChatGPT — an interactive 'chat' bot. Graphics, avatars and songs are also possible with various associated apps. Recently, I was privy to a demonstration of AI technology involving a suitably attired AI-driven professor. She was teaching statistics (logistic regression) and interacting with students very ably. In a similar vein, and with some success, we have trained up an AI-based chatbot to interact with students working on our online industrial automation labs (without divulging the solutions of course).

The tussle between Google and Microsoft and their AI offerings continues; this competition will result in comprehensive improvements.

ChatGPT provides the following note on AI's impact on industrial automation. It is fairly predictable and prosaic:

The greatest impact of AI on industrial automation is the ability to optimize and improve processes through data analysis and machine learning. This results in increased efficiency, reduced downtime, and improved product quality. Additionally, AI has enabled predictive maintenance, allowing companies to prevent equipment failures before they occur, saving time and money.

To apply AI easily and effectively, users should start by identifying the specific pain points in their workflow that can be addressed by AI. They should then evaluate the available AI technologies and select the ones that best meet their needs. Once the appropriate AI technologies are identified, users can work with vendors or consultants to integrate them into their existing systems. Additionally, users can leverage AI development platforms that allow them to easily build and deploy custom AI solutions without needing extensive programming skills. Lastly, users should prioritize ongoing training and upskilling to stay up-to-date with the latest AI technologies and techniques.

After being suitably impressed with ChatGPT when querying process control tuning rules, dismay followed when information on recent industrial automation advances was requested. This is not surprising; the knowledge store on OpenAI is lagging by about two years.

The immediate value in AI tools is the automation of mundane, repetitive tasks: writing emails and reports, for example. It can act as an office chum: providing a starting point, before a necessary content rework to ensure it is applicable to the plant.

Despite the inevitable disappointments, innovation has improved life and business through time: steam during the industrial revolution; electrical engineering in the 1900s; electronics in the 1960s; and the internet in the nineties. AI should see the same positive growth in industrial automation plants in due course. There is a caveat, however: the overriding need for safety will ensure that the uptake is cautious; for instance, ChatGPT could 'hallucinate' (the actual term) while transferring sulfuric acid.

A possible way forward for you:

- Install ChatGPT.
- Investigate the Microsoft and Google options.
- Use Prompt Engineering: to evince accurate answers.
- Use ChatGPT for AI queries and for communication, but be critical!

Finally, the spread of AI may also be impeded by some legal kick-back. After all, the current model relies on harvesting data without any recompense to the originators of the content.

**Dr Steve Mackay has worked in engineering throughout Australia, Europe, Africa and North America for the past 40 years in the mining, oil and gas, and power industries. A registered professional engineer in electrical, mechanical and chemical engineering, he believes university engineering programs need to be strongly focused on industry. He has been the author or editor of over 30 engineering textbooks sold throughout the world.*

40+ CELEBRATING YEARS
wfmedia
connecting industry

Westwick-Farrow Media
A.B.N. 22 152 305 336

www.wfmedia.com.au

Head Office
Unit 7, 6-8 Byfield Street, North Ryde
Locked Bag 2226, North Ryde BC NSW 1670
AUSTRALIA
ph: +61 2 9168 2500

Editor
Glenn Johnson
pt@wfmedia.com.au

Acting Publishing Director/MD
Janice Williams

Art Director/Production Manager
Julie Wright

Art/Production
Linda Klobusiak, Marija Tutkovska

Circulation
Dianna Alberry
circulation@wfmedia.com.au

Copy Control
Mitchie Mullins
copy@wfmedia.com.au

Advertising Sales
Sandra Romanin – 0414 558 464
sromanin@wfmedia.com.au

Tim Thompson – 0421 623 958
tthompson@wfmedia.com.au

If you have any queries regarding our privacy policy please email
privacy@wfmedia.com.au

Contact the editor

Printed and bound by Bluestar Print
Print Post Approved PP100007403
ISSN No. 0819-5447

All material published in this magazine is published in good faith and every care is taken to accurately relay information provided to us. Readers are advised by the publishers to ensure that all necessary safety devices and precautions are installed and safe working procedures adopted before the use of any equipment found or purchased through the information we provide. Further, all performance criteria was provided by the representative company concerned and any dispute should be referred to them.

Information indicating that products are made in Australia or New Zealand is supplied by the source company. Westwick Farrow P/L does not quantify the amount of local content or the accuracy of the statement made by the source.

This issue is sponsored by — **Moore Industries** — www.miinet.com/safetyseries

FREE

to industry and business professionals

The magazine you are reading is just **one of 11** published by Westwick-Farrow Media. To receive your **free subscription** (magazine and eNewsletter), visit the link below.

wfmedia
connecting industry

www.WFMedia.com.au/subscribe

CIPable Unbreakable pH Sensor

Say Goodbye to Broken Glass Sensors

ISM®

APPROVED

CERTIFIED EHEDG TYPE EL CLASS I

METTLER TOLEDO launches breakthrough X-Chip™ technology, InPro™ X1 pH sensors. New InproX1 pH sensors are CIPable, unbreakable, enabling in-line pH measurement in applications with the highest product safety requirements.

- **Exceptional measurement accuracy** for **measuring in-line** leading to higher product quality and increased yield.
- **CIP-able using standard industrial processes** without the need of expensive and maintenance heavy retractable equipment.
- **Easily implemented** with the same standard operating procedures valid for glass pH electrodes.

- ☑ pH/ORP
- ☑ Conductivity
- ☑ Dissolved Oxygen/ CO_2
- ☑ Turbidity/Color
- ☑ Automation
- ☑ Mounting Accessories
- ☑ Water Analyzers

Scan the QR Code to know more about InProX1

Learn more about Process Analytics Instruments

▶ **www.mt.com/pro**

METTLER TOLEDO