PROCESS TECHNOLOGY

AUTOMATION + CONTROL + INSTRUMENTATION

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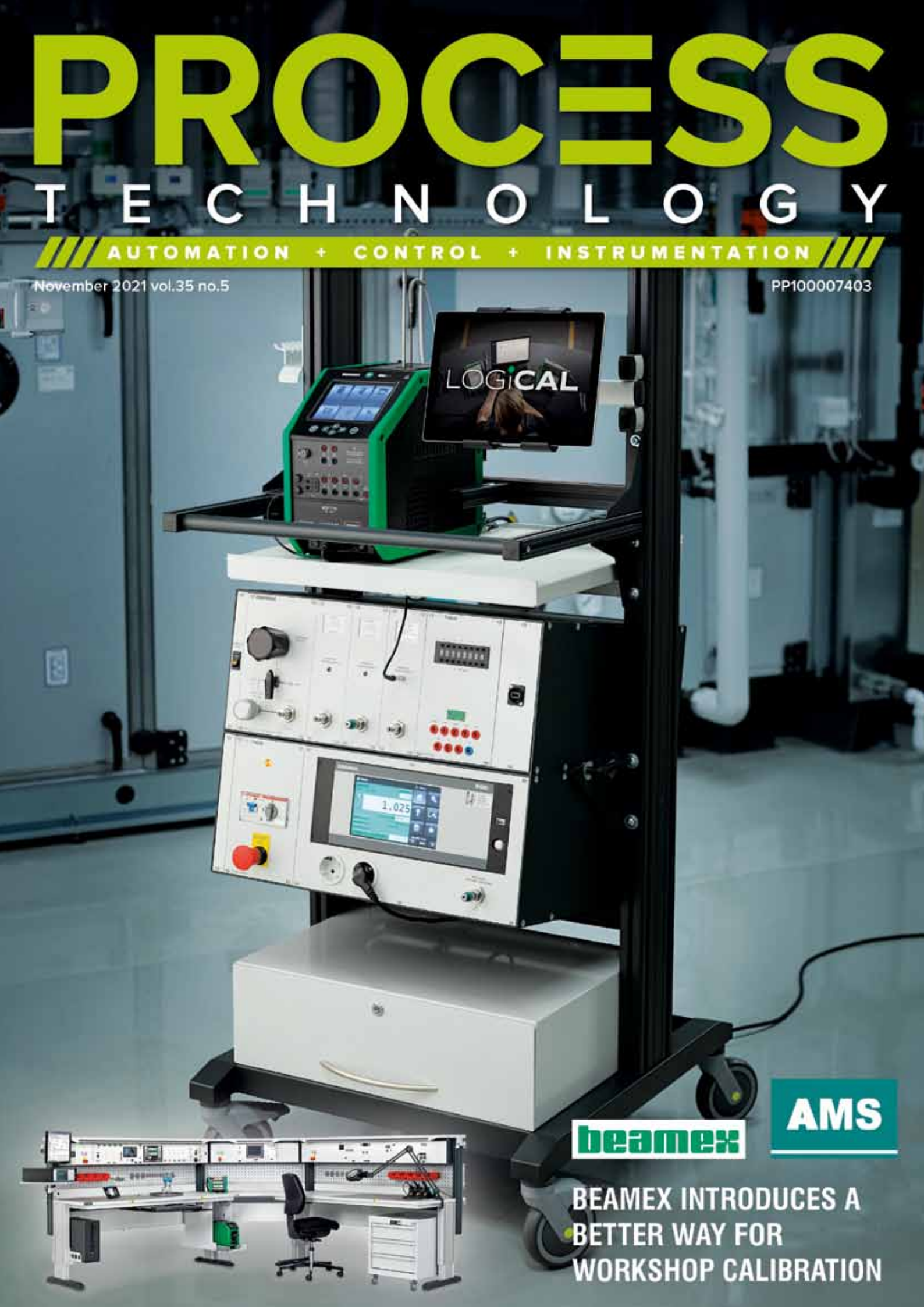

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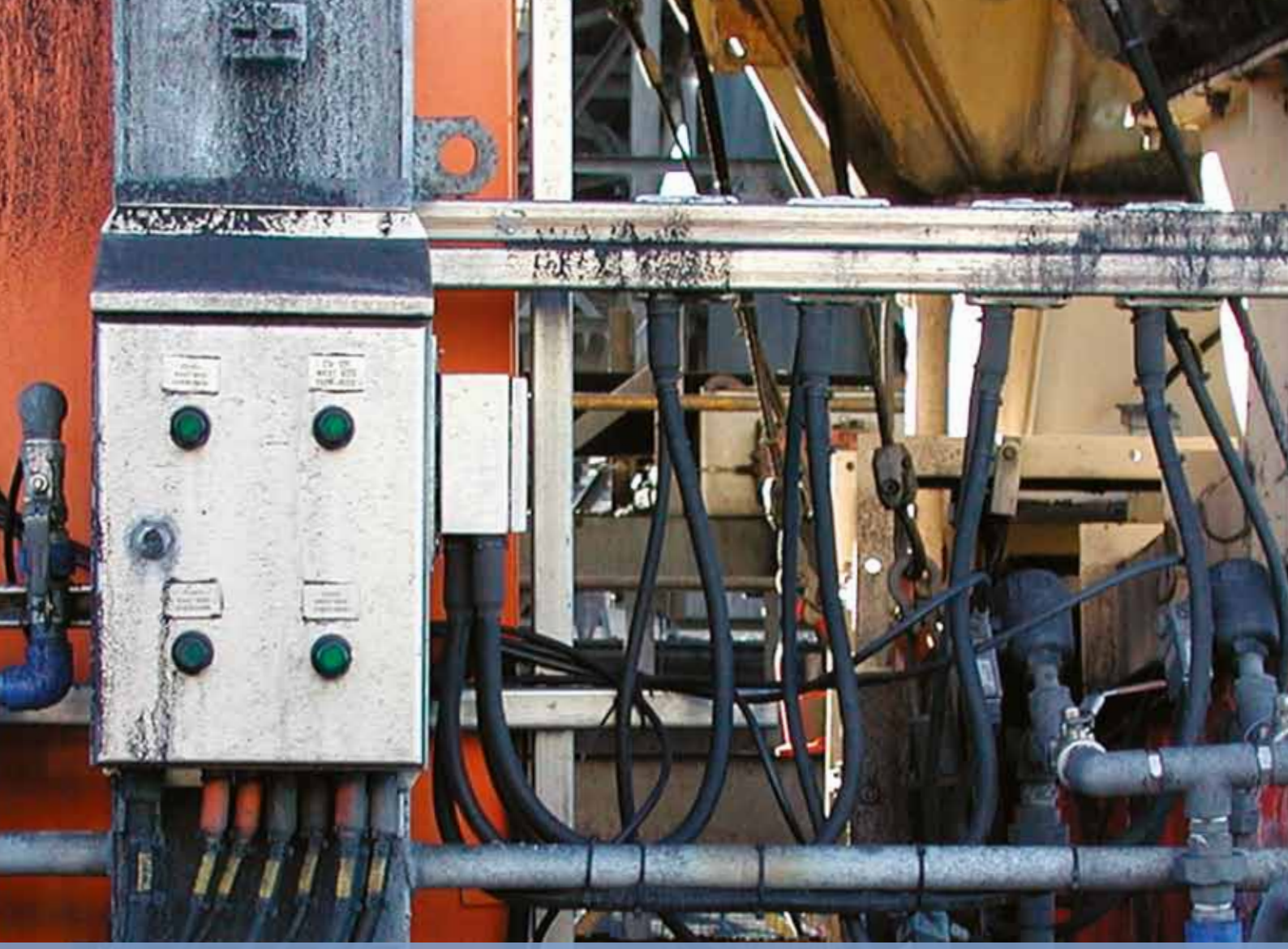
BEAMEX INTRODUCES A BETTER WAY FOR WORKSHOP CALIBRATION



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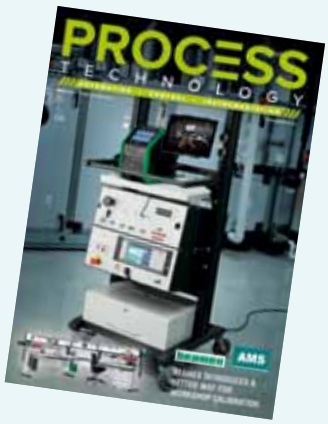

Beamex introduces a better way to perform calibrations in a workshop by introducing a new calibration test bench called Beamex CENTRiCAL.

Even though process instruments are often calibrated in the field with portable calibration equipment, there are situations when it is more effective and convenient to perform calibrations in a workshop. Better accuracy can also be achieved when the calibration is performed in controlled conditions, using dedicated high-accuracy workshop calibration equipment.

The Beamex CENTRiCAL calibration bench reflects the result of decades of experience providing workshop calibration solutions to the industrial process industry. A standard, yet configurable solution, the Beamex CENTRiCAL represents the latest technology combining ease of use, versatility and ergonomics to provide a better way to perform calibrations in a workshop.

The CENTRiCAL is easy to configure to suit individual requirements while the standard electrostatic discharge (ESD) protection offers electrical safety measures as a standard. Each CENTRiCAL is supplied with accredited calibration certificates to ensure quality and traceability. The Beamex CENTRiCAL is available with superb ergonomics via motorised height control, or as a fixed height bench. A straight bench as well as corner modules are available to meet user needs. A trolley-based design is also available for mobile solutions.

AMS

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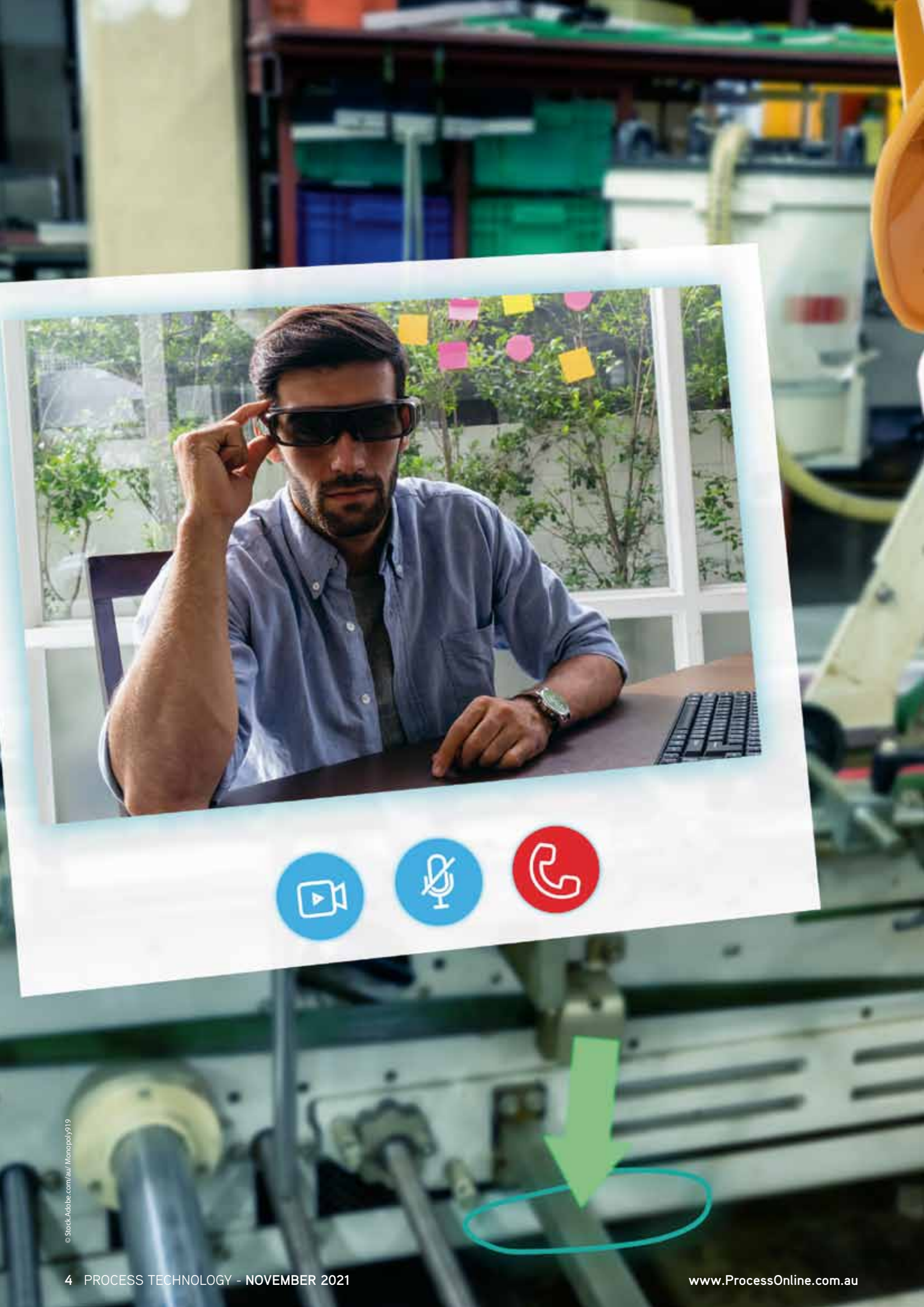
www.ams-ic.com.au



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FROM CHOICE TO NECESSITY

REMOTE CAPABILITIES NOW UNDERPIN THE NEW LOOK OF DAY-TO-DAY OPERATIONS

Kim Fenrich, Global AR/VR and Digital Services Product Manager, ABB Process Automation

Many years ago, somebody wisely pronounced that necessity was the mother of invention, and the past 18 months has proved this beyond doubt.

By now it's fairly safe to assume that you've heard the expression 'new normal' more times than you would care to admit. But stepping away from the fact that it is being applied as an all-encompassing catchall for almost everything 'new' during the pandemic, it has in fact introduced new ways of working that most people — having now experienced the new power at their fingertips — are incredibly eager to adopt and evolve, turning these new working practices into just… the normal.

Key to these new methodologies is digital transformation — another expression saturating the industrial lexicon. Although now a commodity term, by connecting everything, converging IT and OT and massively exploiting data from every possible asset, node and end point, digital technologies are rewriting the rule books regarding what can be done, from where it can be done and who can do it.

But label digital transformation as a passing fad at your own peril. The whole concept of digitalisation was around long before the pandemic and is almost certainly setting the foundations for industry going forward. Indeed, if you have not yet looked at digital technologies and the power of connected devices, you risk being left behind.

Digital technologies arrived just in time

As part of the foundation of digital transformation, it's safe to say that Industry 4.0 methodologies and IIoT technologies arrived just in time. Had we not had the networks, connectivity and bandwidth to be able work remotely — both effectively and seamlessly — the pandemic may well have resulted in a very different industrial landscape. Even a few months made a difference, and sometimes it was even just understanding the messaging and rationale as opposed to actually deploying the technology. Once digitalisation entered the zeitgeist, there was no stopping it.

This interconnectivity certainly existed before the pandemic; indeed, a slightly less connected and not so smart iteration has been with us for the last decade or so. But a few years back, someone swept all these new ideas into a single concept and gave them a cool name: Industry 4.0 was here to stay. Advances in smart devices and connection architectures, speeds and bandwidths have since opened up a more expansive digital playground upon which all manner of 'new-normal' approaches can now be deployed and exploited.

And they're proven! Ask anyone in safety-related functions or high-hazard applications and these early adopters will regale you with anecdotes about how these remote capabilities have made their job not only easier, but far safer too.

Oil and gas leads the way

Oil and gas has been at the forefront (and has been the testing ground) of many of these developments. Markets where high price volatility exist tend to get nervous of any external influences, so they ruggedise and introduce the means to save costs through reduced time and effort, and connected, digitalised technologies have proven a real boon.

It was no surprise therefore that more traditional land-based industries soon found they needed to adapt. When social distancing was announced, pretty much globally,

the collective intake of breath across the manufacturing community was almost audible, as there was simply little time to prepare. However, engineers are a clever bunch and almost instantly we started to hear about virtual factory acceptance testing (FAT) being performed over Skype and remote maintenance off the back of a mobile phone camera. The world could not stop, so we had to adapt to make things happen.

Indeed, the Skype connection was soon replaced by a dedicated, well-lit, high-definition video stream driven by specialised software. And mark-up capabilities moved from the whiteboard in the design office and the end user's boardroom into the virtual environment. It all got very virtual very quickly.

Augmented and immersive tech finds its place

There was already a groundswell of technological evolution into virtual technologies, but it was still not commonplace. But these new remote, virtual, augmented and immersive technologies all of a sudden left the realm of being 'neat bits of kit to play with at a trade show' and suddenly became day-to-day tools that had to be used… or, to put it simply, nothing would happen. Or if it did, it would not be very fast and it would not be very high tech.

The support function has arguably made (and seen) some of the greatest strides in terms of platforms and offerings, with phone calls and emails being replaced by augmented solutions and dedicated apps, designed, supplied and integrated by leading vendors — especially those in the automation space as suppliers of the technology and infrastructure that underpin successful Industry 4.0 solutions.

These and similar solutions deliver immersive interaction between on-site personnel and remote experts, who can then impart real-time instructions and even overlay advice and graphical pointers on live video feeds from the site, line, cell or machine. It's like having a highly knowledgeable support engineer on your shoulder, but they are actually sitting at their desk 3000 km away in Zurich.

Fortunately, it was also recognised that technological agnosticism was essential. This was not the time to force customers to exploit specific technologies or platforms. And for this reason, the most flexible solutions support the most common mobile architectures (iOS, Android and Universal Windows Platform), on tablets or phones.

Ensuring business continuity

As with most support and service functions, the primary goal is to impart the means, advice and knowledge to ensure business continuity. So, giving engineers and operators access to in-depth information about their assets and installed base is another primary deliverable. This capability is especially important with reduced operator counts due to social distancing and isolation. No one single person can be expected to know everything about every machine.

In fact, it is this thirst for knowledge and then imparting it in the correct format to those that need it that forms one of the major pillars of Industry 4.0. And what better way to share this knowledge than through immersive overlaid 'real life' simulations.

As a result, proactive monitoring of machine data and diagnostics, as well as delivering critical information to improve performance with system-specific software updates, means that self-help is just as important as remote help, especially if it can all be wrapped up in a single-point-of-access portal, another solution delivered by leading automation vendors. The end user shouldn't need to rely on vendors 100%: there has to be this element of self-help… with the understanding that the vendor will jump in if necessary.

Aside from machine data, similar analyses can also be performed on production and operational data, using dedicated analytics platforms that deliver a remote software-assisted service that not only helps to optimise operations, increase productivity and minimise costs, but also offers definable thresholds that will notify when imminent actions are required.

The same can be said for spare parts management, where reactive and proactive

maintenance is essential — even with a limited workforce. Having the right parts on hand at the right time avoids the risk of downtime due to inventory gaps or during supply chain constraints. Machines can even be interrogated for working hours and throughput levels and automated maintenance performed, with spares requests generated but still signed off by a person.

The key word with all these services is 'remote', and although things are steadily getting back to normal (there's that word again), it's a good bet that we won't see any mass migrations back to the old ways. People have become comfortable working apart and in different ways and, more importantly, management has found that they can trust employees to work remotely. All it took was a pandemic.

Remote operation: the new normal

In hindsight, sending multiple engineers hundreds and sometimes thousands of kilometres to a factory for three days to commission, install, test or service a machine is a hugely costly exercise — even at cost prices. Sure, foreign trips are nice, but do enough of them and you soon start to yearn for your own armchair. Once everybody had to go remote it was like a huge lightbulb appeared above their collective heads; and something that might have taken years to percolate through the rather traditional psyche of some companies, all of a sudden became standard operating procedure. And it has been global.

> ASK ANYONE IN SAFETY-RELATED FUNCTIONS OR HIGH-HAZARD APPLICATIONS AND THESE EARLY ADOPTERS WILL REGALE YOU WITH ANECDOTES ABOUT HOW THESE REMOTE CAPABILITIES HAVE MADE THEIR JOB NOT ONLY EASIER, BUT FAR SAFER TOO.

So, what's on the horizon for remote operations? AI is looking very interesting as it starts to reach critical mass and is fed more and more use cases to chew on. Indeed, we may well see an increase in autonomous decision-making and operations much earlier than you think, leaving humans to do what they do best by removing them from mundane repetitive tasks and letting them undertake more value-adding activities that require the qualities and mindset of an actual person.

5G is also going to make the communication landscape a lot more capable. Higher bandwidths and higher speeds will mean more feature-rich remote capabilities, which will deliver even greater depth of services and augmented realism to even the most remote location. Staying on the comms front, Power over Ethernet (PoE) is going to create a paradigm shift, especially in dispersed operations. In fact, we may well soon see the final demise of 4–20 mA, as the smart-device revolution percolates down to equipment that has remained dumb because of the limitations of its network synapses. Analog 4–20 mA simply cannot handle the complexity of anything more than an electrical signal, let alone deliver fully featured operational information possible via PoE.

If it is possible to put a positive spin on the last 18 months, this is the result: industry is now more connected and integrated and, arguably, more capable than it has ever been all thanks to the rather swift push over the digital/remote edge that COVID-19 delivered. You could say that this almost wartime level of innovation and flexibility to adapt and adopt has provided the groundwork for the next industrial revolution. Perhaps we are already there.

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1D AND 2D CODE SCANNERS

Wenglor has released 19 new models of its C5PC series of 1D/2D code scanners.

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https://bit.ly/3CCow1h

LASER DISTANCE SENSOR

The Acuity AS2100 laser distance sensor is designed to work well outdoors, in bright light and on difficult targets such as dark, hot and textured surfaces.

Slentech Pty Ltd

https://bit.ly/316pwwJ

EDGE AI GPU COMPUTING PLATFORM

The Nuvo-8108GC-XL is an industrial-grade edge AI GPU computing platform that can support vision inspection and intelligent video analytics.

Backplane Systems Technology Pty Ltd

https://bit.ly/2Y2Ml3n

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AIR SAFETY FUSES

If a pressurised air line bursts, or a hose coupling accidentally releases, this can result in a thrashing hose becoming a dangerous projectile. The dangers increase dramatically if an air tool is attached, or the line is a large diameter. Installing an air safety fuse can eliminate whiplash hazard and guard against accidental puncture or unexpected maintenance issues.

Protect-Air HoseGuard air safety fuses offer simple and effective protection of employees, machinery and equipment. The HoseGuard immediately shuts off the air flow should the volume of air exceed a set value. This value is factory preset to allow normal air consumption when using air tools.

In the event that the air line is severed and the air consumption exceeds the set value, an internal piston instantly shuts off the main flow. An integral bleed hole allows a small amount of air to flow through, enabling the HoseGuard to automatically reset once the main break is repaired.

The lightweight and compact device is suitable for all industry situations where compressed air is used. It is available in aluminium and 316L stainless steel.

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

IO-LINK MASTERS AND HUBS

Turck has expanded its IO-Link range to include IP69K 8-port IO-Link masters with M12 power supply, compact IO-Link masters in IP20 and an I/O-Hub with external power supply.

The TBEN-L-8IOL IO-Link master is now available with L-coded M12 power connectors for up to 16 A. With up to 4 A supply the eight ports can run power-hungry equipment such as grippers. Temperature ranges of -40 to 70°C make the rugged IP69K block modules suitable for machine installation.

The compact IP20 FEN20-4IOL master for four IO-Link devices is designed for use where space is restricted.

Turck's Simple IO-Link Device Integration (SIDI) enables devices and project parameters to be integrated directly into the engineering tool and internal programming logic in the master can control decentralised small-scale tasks in the field. All multiprotocol devices allow data to be queried and processed via Modbus TCP in parallel to existing PLC communication.

The TBIL-L-16DXP-AUX I/O hub with additional external power feed for increased power applications provides consistent galvanic isolation of voltage groups V1 and V2 enables actuators to be switched off safely in an emergency while the sensors remain activated. The I/O hub with universal ports links up to 16 digital inputs or outputs to the IO-Link master. The I/O hubs are available with 7/8″ or M12 power supply.

Turck Australia Pty Ltd
www.turck.com.au

POSITIVE DISPLACEMENT FLOWMETERS

In principle, the flowrate in a positive displacement (PD) flowmeter is calculated from the number of revolutions of a rotor activated by the energy of fluid. Generally, these flowmeters offer high accuracy measurement and are suitable for totalling the flowrate.

The OVAL FLOWPET-5G PD flowmeter is primarily intended for use in boiler feed water and fuel oil metering applications. OVAL says that high accuracy and long service life along with ease of use make this industrial meter suitable as a dedicated tool for heat control.

It has a high accuracy of ±0.5% RD for oil and ±1.0% RD for water, and the flow and instantaneous flow is displayed on a dirt-resistant digital LCD display with touch of mode select switch and a large 14 mm character height. The display can be tilted for better visibility (±75°).

The electronic register-equipped models have an internal, easily replaceable battery with a typical life of years, eliminating the need for an external power source. An external power source is recommended for pulse output models.

The factored pulse width is variable in 1 ms steps with the front panel buttons (adjustable from 1 to 999 ms). Simulated outputs are available for pulse output models, and the pulse and analog output can be simulated at any flow rate for loop tests. A 4–20 mA analog output is also available.

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HOW DIGITISATION CONTRIBUTES TO GLOBAL WATER SUSTAINABILITY GOALS

Industries across the globe use water for fabricating, processing, washing, diluting, irrigating, cooling and transporting products. Water is used in copious amounts across mining operations, smelting facilities, petroleum refineries, chemical production and food processing facilities just to name a few. The apparel industry alone, for example, consumes approximately 79 billion cubic metres of water per year — enough to fill 32 million Olympic-size swimming pools. That figure is expected to increase by 50% by 2030. In the mining, minerals and metals industry, the amount of water it takes to produce a ton of steel (250,000 L) is the equivalent of more than 2 years of consumption for a typical family. Not surprisingly, water sustainability has emerged as a critical issue for fueling global economic growth.

High water demand and its declining supply threaten quality, pollution, climate change, urbanisation, aging infrastructure, spiraling energy costs and evolving regulations are just some of the challenges facing the global water sector. Within their internal operations, water and wastewater facilities confront challenges surrounding water leakages and high rates of energy consumption. In the US alone, municipal wastewater treatment plants are estimated to consume more than 30 terawatt-hours per year of electricity, which equates to about $2 billion in annual electric costs.

Even with these seemingly overwhelming challenges, it is becoming increasingly apparent that digital transformation in water processing and delivery operations can begin to help provide lower energy consumption, higher sustainability and less waste.

Water sustainability strategy relies on infrastructure that enables data transparency

Sustainability starts with the ability to extract performance data from the physical infrastructure that supports core operations. In the water and wastewater sector that means water processing and distribution network transparency and traceability of water assets as they move through municipal systems. To achieve transparency, core equipment such as motors, drives and pumps need to incorporate sensors to collect the necessary data. Then cloud-based software tools

can connect to the various data silos from different sources and consolidate and combine that data with legacy data.

As data is shared back and forth across organisations, trust issues can be addressed by incorporating tools that provide only the necessary and non-confidential pieces of data needed to make accurate decisions in a secure and protected environment. Once access to meaningful data is achieved, machine-learning solutions can be deployed to extract trends from this broad set of data. In this way, faster and more sustainable decisions can be made regarding water assets as they flow through the processes of recycling purification, transportation and, ultimately, consumption.

The highest potential for achieving sustainability objectives lies with training intelligent algorithms, or artificial intelligence (AI), to make sustainability decisions in real-time, incorporating the many data points that no human could process in a timely enough fashion, to yield autonomous decision-making.

Schneider Electric supports such modernisation of water and wastewater operations in several ways. In working with Anglian Water, for instance, one of the largest private utilities in the UK, it introduced a cloud-based holistic solution for water loss management that monitors incoming system performance data on a near real-time basis from multiple data sources. As a result, leaks and anomalies are detected in real-time, work orders are dispatched and repair works are effectively executed. Operators can further recognise where system fixes are being applied and where work is still outstanding. They can now find and repair leaks much faster than in the past. In fact, their operations management team has been able to reduce leakage by 10 million litres of water per day.

An ecosystem of partners is key to success

At Schneider Electric, sustainability has long represented a core corporate strategy pillar and the Corporate Knights, the world's largest-circulation magazine on clean capitalism, has recently named us the most sustainable company on their Global 100 index. We attribute much of this success to our ability to digitise operations. 73% of our investments are directed toward developing newer and even more sustainable solutions. Many of our industrial customers have asked us to share our expertise to help them address both digital transformation and sustainability challenges.

The issue of conserving resources while generating revenues and profitability is a delicate balancing act. No one company can do it alone. Partnership and strategic alliances are critical success factors when it comes to achieving business transformation goals. That's why, when proposing solutions to water and wastewater firms worldwide, Schneider Electric often partners with major technology firms, like Microsoft, who share our passion for sustainable operations and support our cloud-based digitisation solutions. In fact, Microsoft has pledged to become water positive by 2030. In water-stressed regions, they have established a goal to replenish more water than is consumed by their operations.

For more information

A consultant like Schneider Electric, with extensive water and wastewater industry energy management expertise, can help operators significantly reduce energy bills and water leakage. Our global water wastewater experts can advise how new digital tools can be leveraged to modernise operations. To learn more about how digital transformation can lead to more sustainable operations, visit our water and wastewater home page. You can also watch our on-demand webinar Industrial Sustainability: A Roadmap to Decarbonization and Resource Conservation.

Life Is On | Schneider Electric

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se.com/au/www

SIMULATION AND DESIGN SOFTWARE

MathWorks has introduced Release 2021b of the MATLAB and Simulink product families. Release 2021b (R2021b) offers many updated features and functions in MATLAB and Simulink, along with two new products and five major updates. Updated capabilities in MATLAB include code refactoring and block editing, as well as the ability to run Python commands and scripts from MATLAB. Simulink updates enable users to run multiple simulations for different scenarios from the Simulink Editor and to create custom tabs in the Simulink Toolstrip.

R2021b also introduces new products supporting wireless communications. RF PCB Toolbox enables the design, analysis and visualisation of high-speed and RF multi-layer printed circuit boards, while Signal Integrity Toolbox provides functions and apps for designing high-speed serial and parallel links.

In addition to the new products, R2021b includes major updates to Symbolic Math Toolbox, Lidar Toolbox and Simulink Control Design, and other products in the areas of deep learning, reinforcement learning, predictive maintenance, and statistics and machine learning.

MathWorks Australia
au.mathworks.com

SERIAL GATEWAYS

DeviceMaster serial gateways from Pepperl+Fuchs are designed to connect any serial device to plant Ethernet or the cloud. With a large selection of modules and an integrated web server for setting serial communication parameters, the serial gateways support a wide array of modern and legacy equipment.

The serial gateways enable fast and flexible integration of serial devices such as barcode scanners, RFID read heads, scales, printers and vision systems into Ethernet-based fieldbus systems like Profinet, Modbus TCP and EtherNet/IP. With a single gateway, communication with many serial devices can be supported at the same time using a combination of RS-232, RS-422 and RS-485 serial communication protocols.

An integrated web server allows easy configuration of network settings and port parameters for communication with TCP/IP and industrial Ethernet systems while Windows and Linux drivers support PC-based applications.

DeviceMaster servers and gateways are available with 1 to 32 serial ports with DB9 or terminal block connectors for DIN rail, panel and rack mounting. They support RS-232/422/485, Modbus RTU and ASCII for device connectivity.

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

DRY-RUNNING ROTARY SCREW COMPRESSORS

Kaeser Compressors' latest range of dry-running rotary screw compressors features its integrated Heat of Compression (i.Hoc) rotating dryer to provide a source of compressed air at a pressure dewpoint as low as -30°C, with a space-saving and energy-efficient design.

The dryer is integrated into a dry-running compressor and desiccant is contained in a drum through which the compressed air flows. Compressed air drying and regeneration of the desiccant occur continuously within a single pressure receiver but are separated both structurally and in terms of the process. Slight pressurisation of the drying sector ensures that once dried, the compressed air does not reabsorb moisture from the regeneration air flowing by in the adjacent sector.

Following the final air compression stage in the compressor, the hot compressed air is diverted directly to the drying sector of the integrated rotating dryer before it exits the compressor. The heat arising as a result of compression is also used for desiccant regeneration. This heat is freely available as no additional energy is required for the drying process. Low pressure dewpoints of -20°C down to -40°C in special conditions can be achieved by the dryer. It uses the flow of hot compressed air available at the end of the second compression stage for regeneration purposes. The discharge temperature of the dryer following the second stage (the regeneration air temperature) can be increased by a controlled bypass around the first compression stage cooler.

Kaeser Compressors Australia
au.kaeser.com

COMPACT TRIANGULATION LASER SENSOR

The ultra-compact Acuity AR100 triangulation laser measurement sensor offers ranges from 10 to 500 mm with a single case size. It is also fast, with a maximum sampling rate of 9.4 kHz.

The AR100 has a linearity of ±0.05% of the full measurement range for most models, and comes with a Class 2, eye-safe laser (<1 mW) in either red (660 nm) or blue (405 nm). The AR100's enclosure has a rating of IP67, so it can withstand dusty environments and occasional splashes.

The AR100 has a standard RS232 or optional RS485 serial interface for communication with a computer or PLC, and also comes with an analog output of 4–20 mA or 0–10 V. The analog output can be programmed to have a custom measurement span, and the minimum and maximum can be set to any points in the laser's range. This laser triangulation sensor also has a limit output for indicating alarms, which can be useful for triggering an external device when a target reaches a set position. The AR100 also has an external trigger input to take single distance measurements.

The AR100 triangulation laser sensor is suitable for applications with tight size and mass budgets with high performance requirements.

Slentech Pty Ltd
www.slentech.com.au

EDGE COMPUTING

UNEARTHING NEW VALUE FOR MINING AND METALS APPLICATIONS

The mining and metals industries are embracing digital transformation, including IIoT technology and concepts, to achieve new levels of production efficiency.

In addition to fluctuating demand for extracted commodities, the mining and metals industries face several new challenges, namely balancing profitability and production efficiency while managing sustainability and minimising environmental impact.

These industries are embracing the digital transformation journey, which includes incorporation of IIoT technology and concepts so data can be leveraged to achieve new levels of production efficiency. Gathering, storing and analysis of production and machine data form the building blocks in this strategy and are integral to the implementation effectiveness.

Mining, like many other industrial sectors, generates large volumes of data. Much of the initial IIoT discourse focused on cloud computing, which meant that large quantities of raw data would be dispatched to cloud-based data lakes, analysed and used in optimisation algorithms to drive real-time decision-making.

Naturally, mining operations are often distributed throughout many remote locations with limited infrastructure, and this presents some connectivity challenges. When factoring in cloud architecture, data costs and latency, a pure cloud computing solution may not be the best answer to realise the full potential of digital transformation.

Process overview

Mining and metals processing operations consist of many areas with opportunities for improvements through automation and data gathering (Figure 1). Sometimes the automation and communication platforms are delivered as part of OEM machinery or equipment skids, while other times they are 'stick built' with equipment and systems constructed in the field.

PLCs play an important role in almost every area and may include local HMIs. Remote terminal units (RTUs) are also widely used, providing some functionality similar to PLCs and adding remote connectivity features. Increasingly, systems incorporate intelligent field devices like variable frequency drives (VFDs) that can supply extensive operational and diagnostic data. Larger processing areas may rely on a DCS and plant-wide operations may be monitored by a SCADA system.

Following is a summary of typical operations:

- **Extraction:** Pit and underground tunnel equipment and conveyors, characterised by deployment across large areas.
- **Materials handling:** Crushers, stackers, screeners and autonomous vehicles.
- **Comminution:** First-stage SAG mills and secondary-stage ball mills.
- **Separation**: Flotation cells, leaching, thickeners, solvent extraction and filtration.
- **Refining:** Systems such as electrowinning, electrolysis and smelting for extracting and purifying metals.
- **Logistics:** Rail and port operations for handling mining production.
- **Utilities:** Includes electrical power distribution and monitoring to support other systems.
- **Water management:** Systems to supply, treat, store, recover and reuse water to provide the right quantity and quality needed for processing.

Because automation platforms and mining equipment have generally become more intelligent over the years, there are more opportunities than ever for obtaining the right field data and acting upon it to overcome operational challenges.

Edge control platforms surmount challenges

It has been possible for many years to stitch together various traditional automation technologies with satellite and radio communications, achieving some level of automated control and remote visibility. However, these solutions have usually been costly and difficult to create, operate and support.

This has changed with the introduction of a new class of automation platform called an edge controller. An edge controller combines a real-time operating system (RTOS) with a general-purpose operating system (OS) like Linux (Figure 2).

The RTOS provides direct deterministic control and monitoring of field equipment, much like a PLC or RTU. In fact, edge controllers can be used just like PLCs, even if users do not immediately take advantage of additional features, providing a futureproof design.

The general-purpose guest OS enables capabilities such as advanced computing, analytics and data storage. In addition, the general-purpose OS offers much more capable communication options, even over the low-bandwidth connections commonly encountered with mining operations.

Because the RTOS and general-purpose OS are virtualised at the hardware level onboard the edge controller, they are completely independent from both a hardware and software standpoint. In fact, each OS can be independently acted upon and rebooted. However, the two OSs can communicate with each other securely using industry-standard OPC UA connectivity. This unique configuration preserves the robust always-on RTOS operation while enabling modern computing capabilities.

Edge controllers are physically built to withstand the harsh conditions found at remote mining sites, including extremes of temperature, contaminants and vibration. The onboard general-purpose OS offers the following computing advantages:

- **Security:** Includes defences suitable for prevalent IT-like issues such as network storms and denial-of-service attacks.
- **OT connectivity**: Natively supports OT-oriented communication protocols, including legacy versions such as Profinet and Modbus/TCP, as well as newer versions with built-in security like OPC UA.
- **IT connectivity:** Natively supports IT-oriented communication protocols with built-in security such as MQTT and secure sockets (HTTPS, SSL, FTPS), providing appropriately secure communications performance.
- **Flexibility:** Users can develop applications in IT-oriented languages like C, C++, Python, Java and many more.

OT personnel can maintain a focus on the deterministic portion of the system they are most familiar with, and IT personnel can work with the general-purpose system. The two groups can work completely in parallel, or they can coordinate and crossover as needed or desired in a clearly defined manner. Remote connectivity makes edge controllers a natural fit for mining operations, where limited staff may need to support assets distributed over large work sites or anywhere in the world.

Figure 1: Many aspects of mining operations require some level of automation, and nearly every area creates data useful for analysis and operation.

Edge controllers can be integrated into existing systems to provide new capabilities without disrupting proven operation — or they can provide a complete control, monitoring and analytical solution for new installations.

Mining applications with edge control solutions

Below are a few specific mining applications that can benefit from edge control; namely ore tracking, leveraging vibration data, blending and stockyard optimisation and power optimisation.

Ore tracking

Managing ore characteristics and variability are a key challenge after it is extracted from the ground because optimal downstream processing is very much dependent on ore size and quality. The initial materials handling and conveying processes use large mechanical equipment that can be prone to failure if large fragments of ore pass through the system undetected. Therefore, the ability to track ore size as it progresses through processing helps mine operators identify conditions that could potentially cause downstream blockages or mechanical breakdown of equipment, resulting in hours of unplanned downtime.

By leveraging a combination of sensors, instrumentation and edge controllers, the ore loading on conveyors can be analysed. Live parameters like conveyor belt tension can be monitored and analytically compared with historic data. Potential deviations can be quickly identified, and the control system can intervene to prevent a downtime incident.

Ore quality also impacts downstream processing, so tracking ore quality is perhaps the most crucial aspect of managing mine processing plants. The mineral concentration varies in the ore deposit itself. After extraction, ore is sampled and results regarding ore size, fines content, moisture level and more can be transmitted to the edge controller.

While this sampled load of ore is being transported to the processing plant by haulage vehicles, the edge controller can use the raw data regarding ore characteristics to perform analysis through embedded algorithms, and then use the results to determine the most beneficial settings for improved control of the processing plant.

For instance, based on the incoming ore size, the edge controller may adjust the gap on the crusher circuit to ensure higher efficiency. Based on the fines content, the edge controller could adjust downstream mill speed to optimise energy consumption and ensure the milling step produces the optimal size distribution for higher recovery of metal in the flotation circuit. Additionally, the associated dosage of chemical reagents could be optimised for best effectiveness and minimised waste.

Leveraging vibration data

Mining is a mechanically intensive process with many pieces of rotating equipment. Vibration is inevitably a problem, but if it is detected and analysed it can be used to predict impending operational issues.

Mine processing equipment consists of high CAPEX and OPEX items. Tracking key process indicators (KPIs) — such as overall equipment effectiveness (OEE), equipment availability and MTBF — empowers operators to proactively manage maintenance and sustain production levels.

Equipment such as conveyors, crushers, stacker reclaimers, ship loaders and mills are prone to failure due to vibration. At the machine automation level, it is possible to collect a huge amount

of data at a high frequency to measure vibration, temperature and noise via sensors and instrumentation. The raw data itself is too excessive for transmission to the cloud due to costs and bandwidth issues.

A better option is to relay this large volume of machine data to an edge controller, which can then use the raw data inputs to complete some preconfigured computations and send the essential time-series data to a supervisory system. This concentrated information is much more suitable for transmitting via low-bandwidth serial, Ethernet, cellular or other networks.

The operations team can then apply analytics to this time-series data to establish baseline equipment profiles and assess if any part of the system is becoming mechanically compromised from a processing or hardware standpoint.

Blending and stockyard optimisation

Bulk commodities like iron ore and coal are part of complex value chains, and mine operators are challenged to deliver these commodities at the required specification to end customers. Tracking and blending of ore is a vital part of the operation, and edge controllers can help customers track material and optimise supply chain logistics.

Autonomous haulage vehicles have become widely adopted in the mining industry, and it is critical to manage diesel consumption and optimise routes to manage their overall operating costs. Onboard controllers allow for sophisticated vehicle control with features like anti-collision and position monitoring; however, there is no embedded PLC and the vehicles do not have permanent connectivity to a plant network.

Mine operators can get valuable insight from monitoring fuel pump pulses and various other raw data that can be obtained via a controller area network (CAN) bus. CAN bus is an industry standard protocol used with many types of vehicles.

In terms of route planning, the haulage truck routes can be organised in conjunction with other mechanical equipment like excavators and crushers. In situations where a mine excavator goes offline, an associated edge controller can then communicate with haulage trucks via wireless to reroute these vehicles to operational excavators and avoid situations where the crusher remains idle. On the other hand, routes for multiple trucks require careful scheduling to avoid situations where too many haulage vehicles are queueing to offload ore into the crusher plant. This kind of live route optimisation can deliver significant savings for mine operators.

Additionally, raw data paired with analytics delivered by an edge controller can provide rich insights into the integrity of the vehicle, supporting preventive maintenance.

Optimisation of power consumption

Aside from the mechanical intensity of operations, energy consumption of mining assets is another significant part of overall operating costs. Much of the existing power infrastructure is based on diesel generators, and with the ongoing pressure for environmental sustainability, mine operators are also being challenged to reduce emissions associated with diesel generators.

Mining power plants typically run with a large spinning reserve, but there is often little visibility into active plant operations, specifically when energy-intensive equipment is coming online. When there is a lack of coordination for equipment going from standby to duty mode, sites are likely to experience brownouts due to power surges.

In the case of a standalone power plant, diesel generators are well equipped with instrumentation and sensors, and this data can be sent to an edge controller. The edge controller can also analyse other raw data from the processing plant to identify when more power will be needed. Armed with this information and connectivity, the edge controller can make step changes to the power plant through its real-time operating system.

In the case where large energy-consuming items like a SAG or bill mill goes into duty mode, the edge controller can anticipate the need for spinning reserve and interface with the diesel generator to effectively adjust power requirements.

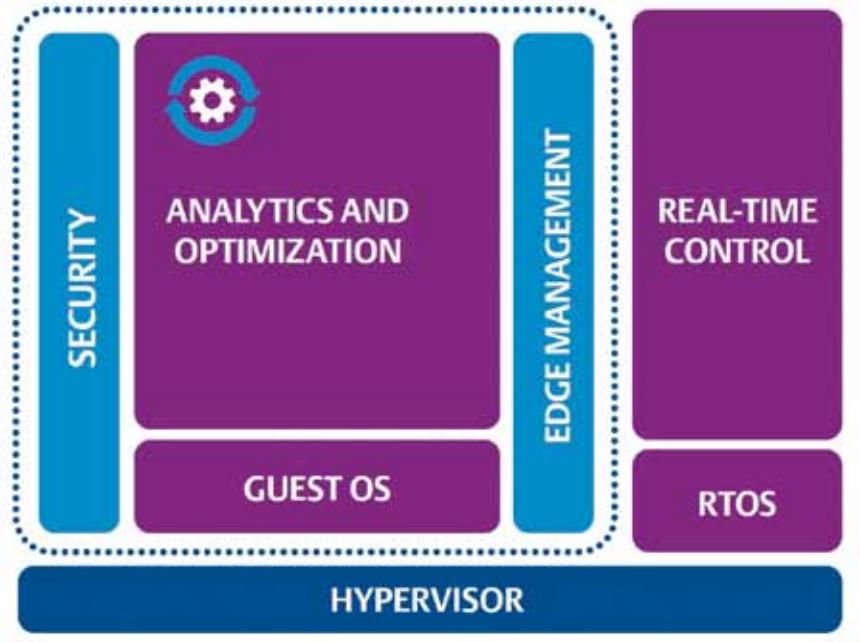


Figure 2: Edge controllers seamlessly and securely coordinate deterministic control with general-purpose computing on one platform.

Conclusion

Mining and metals operations are much more than low-tech digging ventures. These industries are looking for any technological advantage to help them efficiently and cost-effectively adapt to production and market changes in a sustainable and environmental manner. There are therefore many opportunities to realise benefits by embarking on a digital transformation.

Edge controllers are a modern automation platform for enabling digital transformation and effectively applying IIoT concepts. Because mining operations are most often remotely located, any useful technologies must be suitable for these conditions and provide extensive communication options. Edge controllers are built for this OT environment, and have the latest and most secure IT computing and networking features. Edge controllers are especially compelling for this service because they can gather and store data locally, process and analyse it, directly inform operational logic of optimal settings, and relay the most essential information to higher level systems.

Emerson Automation Solutions
www.emerson.com/au/automation

MULTIPROTOCOL COMMISSIONING INTERFACE

Softing's mobiLink Power, the company's multiprotocol interface for commissioning and maintenance of field devices in process automation, can now be used with Emerson's AMS Instrument Inspector to access FOUNDATION Fieldbus devices.

mobiLink Power is designed to simplify mobile access to field devices for process industry operators and supports the three most used communication protocols: HART, FOUNDATION Fieldbus (FF) and Profibus PA. It has an integrated power supply, which eliminates the need for additional components during use in workbench applications. An FDI CommServer (Field Device Integration Communication Server) is now available for the interface, making it fit for accessing FF devices with Emerson's AMS Instrument Inspector.

The AMS Instrument Inspector provides a simple device integration solution that allows users to easily perform basic device configuration tasks. The uniform FDI standard solves the problem of integrating field devices with the multitude of networks, operating systems and control systems used in the process industries. FDI offers a futureproof solution for uniform device integration for all control systems, field devices and protocols.

Ti2 Pty Ltd
www.ti2.com.au

IIoT EDGE CONTROLLER

The ICP DAS WISE-5231M IIoT edge controller is designed to function as a control unit for use in remote logic control and monitoring in various industrial applications. It offers a user-friendly and intuitive website interface that allows users to implement IF-THEN-ELSE control logic on controllers with a few clicks; no programming is required. It also provides mathematic operations, scheduling and email alarm message-sending functions.

The product also provides support for I/O data logging as well as IoT platform integration. With an MQTT client/broker it can directly connect to major public IoT cloud platforms such as Microsoft Azure or IBM Bluemix. It also provides CGI command functions to integrate with IP cameras for access control applications.

The device is suitable for use in applications such as unmanned facility monitoring, intelligent factories and environment monitoring.

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

BULK BAG DISCHARGER WITH FLEXIBLE SCREW CONVEYOR

Flexicon has released a mobile bulk bag discharger with mobile flexible screw conveyor that allows for dust-free discharging of bulk solid materials and conveying to downstream process equipment or storage vessels throughout a plant.

Mounted on locking castors, the BULK-OUT BFF Series discharger has four adjustable extension posts to accommodate bulk bags 915 to 2135 mm tall. The removable bag-lifting frame with Z-CLIP strap holders allows bulk bags to be attached at ground level, then forklifted into receiving cups on the discharger frame.

A SPOUT-LOCK clamp ring atop a pneumatically actuated TELE-TUBE telescoping tube secures the clean side of the bag spout to the clean side of the equipment, and exerts continuous downward tension on the bag as it empties and elongates, promoting flow and evacuation. A vent port with filter sock contains dust.

Additional flow is afforded by FLOW-FLEXER bag activators that raise and lower opposite bottom sides of the bag at timed intervals into a steep V shape, and top-mounted POP-TOP extension devices that elongate the entire bag, promoting total discharge with no manual intervention.

The discharge housing of the mobile flexible screw conveyor is supported by a mast affixed to the mobile discharger frame, allowing the transfer of free- and non-free-flowing bulk materials to multiple destinations. The flexible screw is the only moving part contacting material and is driven by an electric motor beyond the point at which material is discharged, preventing material contact with seals.

Flexicon Corporation (Aust) Pty Ltd
www.flexicon.com.au

INDUSTRY 4.0 TECHNOLOGY ENABLERS IN THE FLUID POWER INDUSTRY

Industry 4.0 technology enablers are a group of diverse technologies — spanning machine learning and robots to additive manufacturing and cloud technology — which work together in an ecosystem.

And yes, I know these technologies sound like they would more broadly supplement the fluid power industry than impact it directly, which brings to the fore the question as to how Industry 4.0 does in fact impact the industry. It's a fair question which depends on the enabling technologies, as some are more relevant than others.

When it comes to, for example, cloud technology, we use it but don't make it. This also applies to robots which we don't produce but use in our manufacturing.

So, which of these technologies is going to be of more interest? From our perspective, only a combination of technologies will work as a solution for Industry 4.0. And within these technologies, predictive maintenance is of the most interest as an outcome, because it's where technology can have the most impact.

Broadly speaking, the different types of maintenance include reactive maintenance, which centres around repairing breakdowns when they occur, and preventive maintenance, which centres around mobile or stationary machine service interventions at scheduled intervals before breakdowns occur.

In contrast, predictive maintenance service work is done on an as-needed basis, with the assessment as to when to intervene based on sensor technology.

It's all about predicting a machine's future state — which, in a nutshell, entails collecting data on how the machine behaved in the past — then to apply this knowledge to the present and then to predict a future state.

This has traditionally been called 'condition monitoring' in the context of industrial applications. But condition monitoring has been around for a while, with the question arising as to what has changed to enable it to form part of Industry 4.0. From the outset it does simply sound like a change of terms and therefore not of much interest to us. But it's a lot more than that.

Predictive maintenance is different to what we previously called condition monitoring, which basically looks at the current state of the machine and takes readings on it. Predictive maintenance instead hinges on the technology of accurate forecasting. Another difference is that more is done with the information gleaned. Now, with Industry 4.0, it's about collecting data on the machine passively all the time and in real time, which was not the case previously.

The fact that information is recorded in real time means that the period between readings is less, enabling increased accuracy when assessing the machine and pinpointing failures at their starting point. This can be applied to all machines and not only new machines.

But what are the benefits of predictive maintenance? There's obviously the question of whether real-time condition monitoring has a greater benefit and return on investment, taking into account the cost of training people and placing sensors onto machines.

The answer here is a definitive yes, as long as the predictive maintenance works — keeping in mind that anything applied runs the risk of not working.

To work it needs buy-in from all business personnel. A common problem with predictive condition monitoring is that a slot set aside to service a machine is sometimes cancelled due to the production department piping up that it needs the machine to keep production schedules. However, if the maintenance department has the authority to adhere to plans, then data collection performed will bear fruit and there will be a return on investment.

The next question is why would condition monitoring be required on a machine that is more reliable as a result of the processes in place to ensure its reliability?

Here the important point to note is that once a machine has become reliable, putting sensors on it and collecting data helps to predict future performance, taking into account that all machines need interventions and repairs at some time. The advantage of the sensors is they enable the collection of data for more accurate machine predictions.

Through my training I've discovered that what works is to get people thinking about maintenance in the first place, which revolves around mechanics repairing machines in the Australian setting. However, of fundamental importance is the idea that the function of the maintenance department is to maintain machines — otherwise it would just be called the repairs department. So it's all about having the knowledge, skills and technology to be reliable.

Paul Marley has been involved in the fluid power industry for over 30 years as a hydraulic fitter and technical trainer. Paul is passionate about smart digital technology, advanced manufacturing and doing his bit to reduce the country's hydraulic engineering skills deficit.

LOW DEW-POINT HYGROMETER

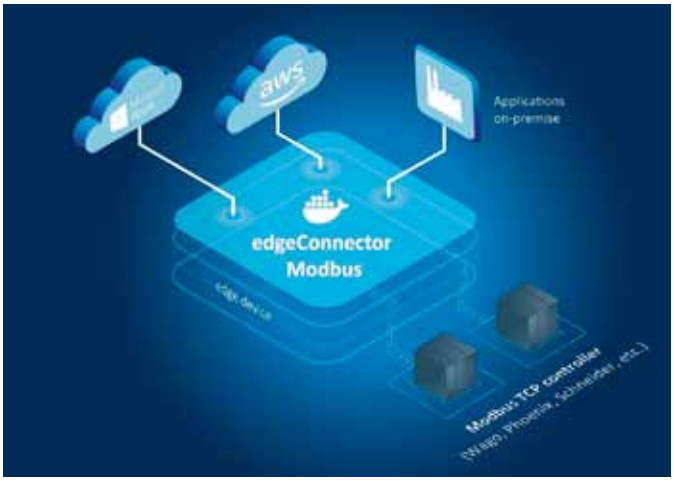
The Michell S8000–100 is a high-precision, low dew-point hygrometer designed to meet the demands of humidity calibration and standards laboratories. The device utilises chilled mirror technology to achieve repeatable measurements of low dew-points down to -100°C, with an accuracy of ±0.1°C, without the need for additional cooling.

At the heart of the new instrument is an optics system that detects minute changes in moisture condensed on the mirror surface. This ensures high sensitivity and fast response to changes in frost point, even at low levels of humidity, where measurements are the most challenging. The S8000-100 high-precision chilled mirror hygrometer achieves ±0.25°C stability at -100°Cfp in less than 6 h, and achieves a reproducibility of ±0.15°Cfp reproducibility at -100°Cfp.

The S8000-100 is also small and light at 22 kg and fits into a 19″ rack or can be used comfortably on a bench. There is no need for operators to monitor the instrument continuously as it offers complete automation and remote monitoring via software.

Typical applications for the S8000-100 are as a reference hygrometer in standards laboratories, humidity calibration facilities and precision moisture measurements for research and development.

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



EDGE SOFTWARE MODULE

After edgeConnector Siemens for connecting SIMATIC S7 controllers and edgeConnector 840D for accessing data from SINUMERIK 840D controllers, Softing has now introduced edgeConnector Modbus. This Docker Container is suitable for connecting Modbus TCP controllers, from companies such as Schneider Electric, Wago, Beckhoff or Phoenix Contact, to industrial IoT applications. edgeConnector Modbus can also be used to collect energy data or other process variables from Modbus-compatible sensors. An integrated OPC UA server enables simple and secure data connection to higher-level management systems, such as ERP, MES or process visualisation systems. As a further communication protocol, MQTT makes it possible to integrate control data directly into private or public IoT cloud applications.

All edgeConnector products support current security standards such as SSL/TLS, X.509 certificates, authentication and data encryption. They are easy to configure locally via an integrated web interface or can be managed remotely via a REST API.

edgeConnector Modbus can be downloaded from online directories such as Docker Hub or Microsoft Azure Marketplace.

Ti2 Pty Ltd
www.ti2.com.au

HYBRID CABLE FOR MOVILINK DDI

Hybrid cables for drive technology are characterised by their ability to combine energy and data transmission in one cable. In the case of SEW-Eurodrive motors with MOVILINK DDI interface, the drive manufacturer relies on a coaxial element for the data transmission of motor information.

Cable manufacturer igus offers a range of hybrid cables, now with a cable designed for SEW motors with the MOVILINK DDI interface.

For the CF280.UL.H207.D hybrid cable, four energy cores have been combined with one coaxial core and two control pairs. By merging two cables into one, users can save 40% space in the energy chain. At the same time, the weight that has to be driven by the system is reduced, which means that less energy is consumed. The cable with a PUR outer jacket can be used for applications with a bending factor of up to 15xd and is therefore suitable for a wide range of industries, from machine tools and material handling to the automotive industry.

Treotham Automation Pty Ltd
www.treotham.com.au

DC/DC CONVERTERS UP TO 100 W

With the QUINT DC/DC converters for the power range up to 100 W, Phoenix Contact is now offering a combination of preventive function monitoring and high power reserves in a compact size.

With their compact, slimline design, the DC/DC converters are designed to ensure more space is available in the control cabinet. Easy system expansion is possible with the static boost capability, providing sustained power of up to 125%. To start difficult loads, the dynamic boost provides double the output power for 5 s. Preventive function monitoring reports system-specific, critical operating states before errors can occur.

Selectable power thresholds or DC OK signalling enable output parameter monitoring that is tailored to the application. The DC/DC converters are also said to have a high efficiency of up to 94% and a long service life, with low power dissipation and low heating. There is also a choice between push-in and screw connections.

Phoenix Contact Pty Ltd
www.phoenixcontact.com.au

NEW PRODUCTS

MANUAL PRESSURE CONTROLLER

The Ralston ControlPak is a manual pressure controller that includes everything needed for precise pressure calibration when using an external compressed gas source.

It features a large, pressure-balancing piston for pressure control encased in a durable, tactical plastic that protects the controls from mud, heat and extreme weather and makes it easy to transport to a test site.

The user need only connect the ControlPak to a nitrogen tank to start calibrating onsite.

With a wide pressure range of 200 kPa to 20 MPa, the product allows the testing of multiple devices in a single set-up, including differential and static calibration, even at very low pressure. The fine-adjust piston, fill, balance and vent valves are clearly labelled and intuitively arranged in the unit, which also includes storage space for hoses, adapters and accessories. All inlet and pressure port fittings are Quick-test, and require no tools or thread tape for secure, leakproof connections.

Ralston Instruments LLC
www.ralstoninst.com

ELECTROMAGNETIC FLOWMETERS

Endress+Hauser's Proline 10 range of Promag flowmeters cover a wide range of basic applications in all kinds of industries.

The electromagnetic flowmeters are suitable for measuring the flows of conductive liquids, as well as for volume measurement of water and corrosive liquids (Promag W/H/D 10) and chemically aggressive fluids (Promag P 10).

The flowmeters meet the demands of basic applications in the water and wastewater, food and beverage, mining, minerals and metals, chemicals, power and energy, life sciences, utility and other industries. They can be used, for example, for measuring raw water, cooling water, process water or wastewater. Typical applications include volume measurement, consumption measurement, process monitoring, pump control and dosing measurement.

A commissioning wizard enables the devices to be configured on site either using the auto-rotatable and high-contrast LCD touch screen or the SmartBlue app via Bluetooth. The latter approach is particularly useful when devices are installed at difficult-to-access locations.

Endress+Hauser Australia Pty Ltd
www.au.endress.com

WATER-GLYCOL COOLING CIRCUITS FOR HYDROPOWER PLANTS

HYDAC's cooling division has released a range of water-glycol cooling circuits (WGK) designed specifically for hydropower plants with a capacity up to 30 MW.

The HYDAC WGK is a compact system for closed cooling circuits that works with coolants such as water-glycol or water. The system consists of a motor-pump unit with displacement ranging from 50–1500 L/min to provide the desired flow for optimum cooling. Additional smart sensors and valves can be added as required.

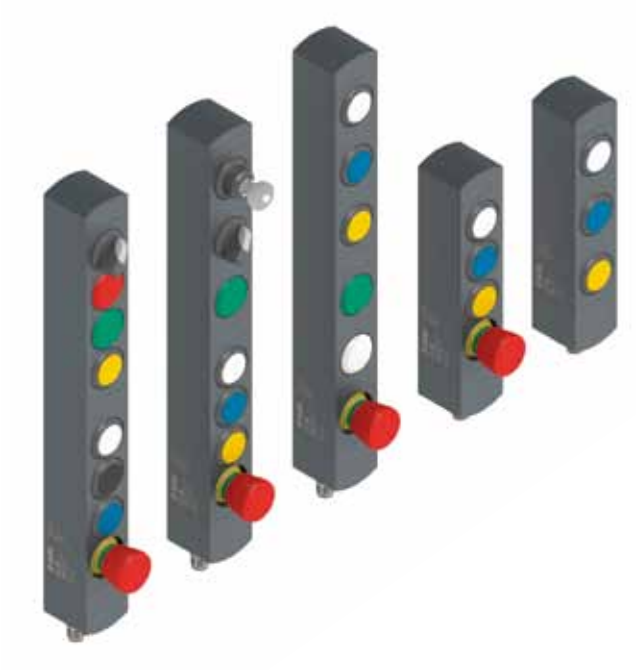
When energy is generated by hydropower plants, heat losses arise due to copper windings and bearings heating up. Applications such as generator, bearing oil and control oil cooling are required to increase efficiency, keep bearing shells at a constant temperature and prevent other damage and increased wear. The coolant is normally re-cooled via heat exchangers positioned underwater or via additional air coolers and plate heat exchangers.

WGK features include customisation to desired flow rate as a result of a modular cooling system and an optional redundant motor-pump unit for increased availability and safety and 3/2 way mixing valve to keep the coolant at a constant temperature.

The WGK's modular structure allows additional components to be added according to requirements.

Benefits include a compact and particularly low-maintenance system, easier planning due to consistent design and quick and easy pressure vessel testing with low coolant loss.

HYDAC International
www.hydac.com.au



SAFETY CONTROL DEVICE UNIT

The BN series safety control device unit from Pizzato Elettrica is an easy-to-install, plug-and-play device.

During installation, the fixing modules can be rotated on the top and bottom of the device to enable variable orientation of the control devices (3 x 90°). This is achieved by loosening the screws and the device body can then be turned in steps of 90° and fixed in the desired position.

The fixing screws are protected by push-in caps, which not only prevent dirt from accumulating, but also block access to the screws and makes it less likely someone will tamper with them.

The BN series control device unit is available in various configurations for various types of applications: for standard applications, configurations with 3 or 4 devices are most suitable, while configurations with 6, 7 or 8 devices are available for more complex applications to provide the user with more control and signalling devices at the same location.

In all the configurations, a variety of control devices can be installed, also illuminated by integrated LEDs.

The modular BN series from Pizzato can be combined with RFID safety switches with solenoid locks of the NS series. Machine manufacturers who already use these devices have the option to attach the control device unit directly next to the safety switch that is identical in shape and dimensions.

Leuze electronic Pty Ltd

www.leuze.com.au

Machine press manufacturer cuts costs by monitoring energy consumption

Aida Engineering Malaysia, a subsidiary of Japan-based Aida Engineering Co, develops, manufactures and sells press machines ranging from 80 to 300 tons.

Established in 1995, the subsidiary manufactures more than 500 press machines annually for markets worldwide and plays an important role as one of Aida Engineering's five manufacturing bases outside Japan.

The challenge began when the local power provider pointed out that the Malaysian subsidiary's six-month energy consumption exceeded 3 million kWh in total. The company was obliged to hire a dedicated energy manager who would be responsible for checking monthly electricity consumption and reporting it to local authorities every six months.

The company's first response was to monitor its power consumption and try to cut electricity bills by identifying peaks. There are two types of electricity rates in Malaysia, depending on the time of day; therefore, if the peak in the factory's power consumption comes when the price is high, it would be preferable to shift that demand to the time of day when electricity costs are lower.

Initially the company could only manually check the power meters and write down the figures, but this way of recording the data didn't help to identify the peak, since the company could only see the monthly consumption. A clearer understanding of the peak levels would require continual measurement of the electricity consumption, perhaps every 30 minutes.

In order to visualise its power consumption more effectively the company turned to Mitsubishi Electric, who suggested an energy-saving data collection server called EcoWebServer III. EcoWebServer III can be part of a demand management system, as it collects power consumption data from facilities and equipment via a LAN and enables remote monitoring from the operators' PCs. It can also send out an email alert when consumption increases rapidly.

A key feature of EcoWebServer III is the capability to constantly measure real-time power consumption data and visualise it as a graph in order to compare it with target figures.

Along with the EcoWebServer III, the company also installed Mitsubishi Electric's EcoMonitor Series energy measurement units to measure the energy use of equipment and individual production machines. Each dataset was compared and analysed in order to promote peak-shift initiatives. For example, the company turned off the air conditioning when using machines that consume a large amount of electricity, while also trying to use such machines in the evenings when air-conditioning demand was low.

"By shifting the peak demand to the time of day when the energy price is low, we were able to reduce our electricity bills by 15%," said Hideki Mawatari, Maintenance Manager. "The effect was immense. We were able to collect the data we needed, and what's more, the payback period was shorter than one year.

"The EcoWebServer III was very easy to install," he added. "We considered other choices, but what attracted us about Mitsubishi Electric's solution was the fact that the EcoWebServer III can be easily connected with existing equipment. It is also scalable, so we can add up as we go along."

Having succeeded in shifting the peak energy demand, Aida Engineering Malaysia's next challenge is to reduce the total amount of energy it consumes.

Energy saving could be simply executed by turning off all machines, but then you are unable to produce, leading to reduced income. Air conditioning was initially meant to maintain the quality of the products, so a long downtime could potentially impact production quality.

"Our focus now is to maintain product quality and reduce energy consumption at the same time," said Mitsuru Hirasawa, Managing Director. "We will increase the number of items we collect data from, and will utilise EcoWebServer III to determine the energy per unit produced (EPU). We also have plans to introduce preventive maintenance and integrated management of energy and production data, which we will eventually make accessible from the factory floor."

EcoWebServer III can be connected to PLCs to collect production data in real time, making it easy to visualise power consumption on a per-unit basis. By making the data accessible from the factory floor, it will encourage factory workers to promote energy-saving initiatives. As a result, power consumption should start decreasing on a per-unit basis, which will eventually lead to saving total energy demand.

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THE OT DATA REVOLUTION

Alvis Chen, Marketing Manager, Moxa

Operational data is the foundation of industrial digital transformation.

In the past, the companies with the fastest or most advanced automation equipment would have stood head and shoulders above the crowd in the industrial automation game. However, with the surfacing of issues such as increasing labour cost, an ageing population, the reduction of available land and the emerging awareness of environmental protection, the original strategy of simply increasing production line capacity is simply not viable enough anymore. Fortunately for industry, another door has opened thanks to the rapid development of technologies such as cloud computing, big data analysis, AI and machine learning. As a result, 'digitalisation' and 'intelligence' have emerged as the next big things in industrial automation development and are set to lead new advancements.

The three stages of digital transformation

Industrial digital transformation is a gradual process that is divided into three stages:

- **Digitisation:** The converting of physical state information from an analog format to a digital format.
- **Digitalisation:** The establishment of an automated process or system on top of digitisation. Examples can be found in a digital dashboard, a secure digital network for remote maintenance or a system that monitors the connection between a traditional power grid and renewable energy sources.
- **Digital transformation:** This refers to the process that involves comprehensively collecting, integrating and analysing different types of relevant data in a system. Subsequently, it creates a new digital-based operation and business model.

The pillar of transformation: OT data

The key to successful digital transformation lies in OT data, since the first stage — digitisation — is the collection of a large amount of OT data. With each successive stage, more value is added to the existing OT data.

Industrial digital transformation is a process in which value is continuously added to OT data, fundamentally changing OT data across multiple dimensions, specifically in terms of its quality and quantity.

Qualitative changes to OT data

Industrial digital transformation has brought qualitative changes to OT data. We can consider these changes from two different dimensions: purpose and impact.

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The purpose of obtaining data: from monitoring to optimisation

Originally, OT data was obtained to monitor and control a system. Its purpose was to ensure that the system can meet the expected requirements or goals, such as monitoring whether the equipment or system is operating correctly, or controlling the equipment's operating efficiency to meet expected goals.

However, in the digital transformation era, the purpose of obtaining OT data has since changed from monitoring and controlling to optimisation. Such optimisation creates tailored, long-term strategies that are evidence based. Through in-depth analysis of OT data's composition and modification, the key factors affecting operational performance could be indicated and managed for a better system. In more developed digital transformation projects, common optimisation goals include:

- **Improving reliability:** Preventive maintenance can be implemented to improve the reliability of equipment, as well as anticipate and prevent anomalies from occurring.
- **Optimising overall equipment effectiveness (OEE):** Identifying idle equipment in the factory to improve OEE.
- **Reducing cost:** Let's take the example of a water pump. Instead of starting the pump whenever necessary, it is adjusted to pump water during those periods when high demand forecasts overlap with the seasonal electricity discounts to reduce costs.

Thus, the chance of bringing forth an innovative and competitive business model transformation depends largely on users having the ability to reduce costs and increase efficiency through analysis and optimisation.

The impact of data: from the edge to the core

Traditionally, OT data refers to data that exists in sensors, meters, controllers or monitoring platforms, such as SCADA. Most of the data is discarded if the operating system is running smoothly.

OT data, however, is about to be taken to a new level. The biggest difference between the OT data of the past and the OT data of the digital transformation era is the latter has been shaped into an integral part of an enterprise. Compared to its old self, OT data is now a digital asset meant to be used by other digital systems and can generate higher values through various interactive analyses and integration. Thus OT data's influence has increased exponentially by playing an integral part in business decision-making. With the growth in its importance, simply maintaining the stability of OT data is no longer enough. For enterprises to step into digital transformation smoothly, high-quality data is now required. But what is considered 'high-quality' for OT data?

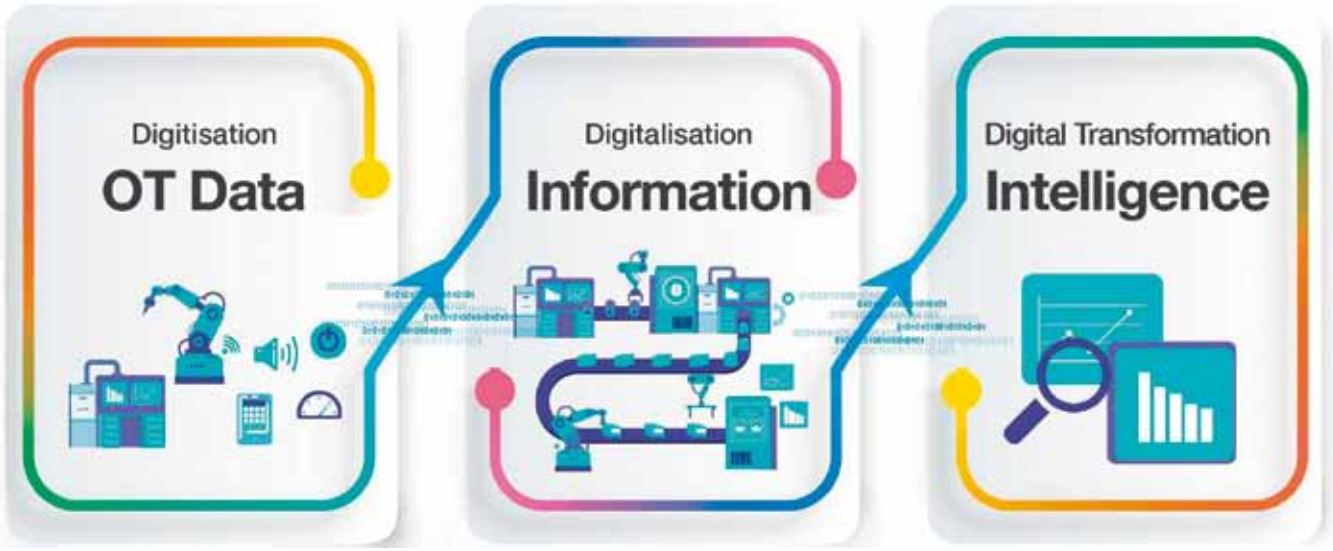

Figure 1: The three stages of industrial digital transformation.

Quantitative changes to OT data

In addition to qualitative changes, OT data has also undergone quantitative changes. We can consider these changes from four different dimensions: variety, velocity, volume and veracity.

Variety: requiring deeper and wider data

The traditional control system already relies on a large amount of OT data to operate. Operational data, which is used to indicate the operating status of a system at a certain time, can be simple, such as the position of a water gate and daily oil production, or it can be complex, such as production recipes, processes, etc. However, digital transformation requires more diverse data on two levels:

- **Deeper data:** Take the predictive maintenance of CNC machines as an example. To accurately predict when certain machines would require maintenance or provide pre-emptive upkeep, more in-depth information is required. In addition to the basic machine operating status, the vibration frequency and current value of the motor must also be collected for analysis. Therefore, in this case, additional vibration sensors or meter measuring instruments are needed to obtain the 'deeper' data.
- **Wider data:** 'Wider' data is basically cross-spectrum data that needs to be analysed with other systems or even third-party data. For example, to ensure overall power grid stability, traditional power companies need the power output estimations from renewable energy companies. To make these estimations, renewable energy companies have begun to incorporate weather forecasts as an important reference. Hence, to garner information for the power grid that is both useful and comprehensible, data needs to be pulled from a wide spectrum.

The foundation of digital transformation is built on data that is not just found at the core of a control system but also 'deeper' in critical equipment of the same system and 'wider' from other systems.

Velocity: requiring circular feedback of data

The main reason traditional automation systems focus on real-time data is to gain better control of the devices. In digital transformation, 'real time' refers to the promptness in displaying, analysing and feeding back OT data.

By combining the capabilities of big data processing and edge computing technology with faster network transmission, a large amount of OT data can be converted into a format that allows for real-time or near-real-time streaming. This creates a continuous and accelerating OT data cycle, which starts from the equipment and flows continuously to the IT system for analysis. The analytic results are then immediately fed back to optimise the operating efficiency of the OT equipment. Thus, an effective 'circle of life' for OT data is born.

Volume: requiring reliable networks to stream more diverse data

A large-scale automation system (for example, the DCS of an oil refinery) could already process hundreds of thousands of data inputs per second in Industry 3.0. However, once the machines stopped working, the data lost its value.

Digital transformation makes sure no data is left behind. By obtaining large amounts of data, digital transformation seeks the meaning beyond the surface value, and the potential influences between a wide variety of data, so that it will keep working and create value, even when machines are not. A network that can easily transmit a large amount of OT data is needed in order for each system to obtain and share each other's OT data.

However, providing an OT transmission network that offers stable and uninterrupted transmission of massive volumes of OT data is a challenge still waiting to be resolved.

Veracity: requiring the security of data and networks

Digital transformation is a data-driven movement, thus elevating the importance of the accuracy and security of data. OT data may include information regarding special production processes or even operational details of the monitoring equipment of key infrastructure or manufacturing facilities. If this important information is incorrectly or maliciously tampered with, it could cause immeasurable loss.

The protection of the basic data transmission network between IT and OT is critical. Connecting OT equipment with IT systems for data transmission normally results in a much more complicated network that is vulnerable to cyber attack at many entry points. Ensuring the security of OT data is a critical lesson every company must prepare for prior to entering the digital transformation arena.

Dealing with the qualitative and quantitative changes of OT data

The qualitative changes of OT data brought forth by the digital transformation are prompting organisations to set new goals. Subse-

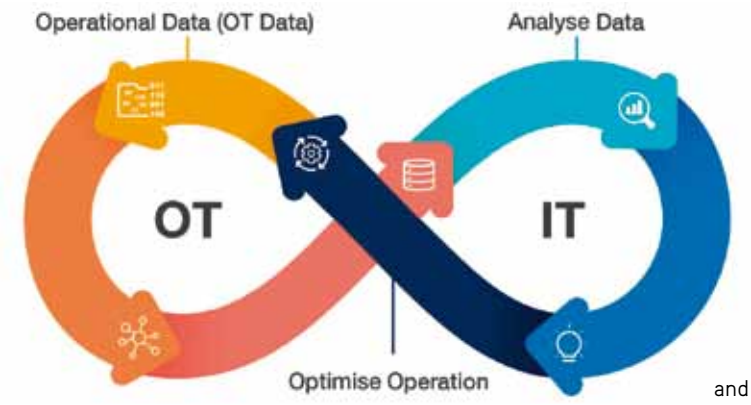

Figure 2: Circular feedback of data.

quently, enterprises must now consider how to make corresponding changes. Most companies that have successfully pushed through transformation have adopted the following strategies:

- **Set clear long-term goals for the organisation:** Clear, long-term goals ensure that everyone is on board before each department sets its own priorities, so that everyone can gradually move cohesively towards the finish line.
- **Set KPIs to help with cross-departmental integration:** Joint cross-departmental projects break down the barriers between departments and help employees at different organisational levels understand the benefits of digitalisation and cross-departmental integration.
- **Start small:** Test run with a small project. Small projects often reflect what works and what doesn't within an organisation relatively quickly.

When facing the four quantitative changes in OT data (variety, velocity, volume and veracity), enterprises must adapt the attitude of continuously learning and embracing digital technology. This will help you transition smoothly into digital transformation.

Variety

Facing challenges from the so-called 'variety' changes, consider adding two OT data-related skills:

- **Analog/digital conversion:** To obtain more in-depth operating data from key equipment, especially ones without digital format conversion capabilities, consider installing new industrial-grade sensors, supplemented by remote I/O devices with analog/digital conversion functions.
- **OT equipment communication protocol conversion:** Since different equipment or OT systems use different data communication protocols, cross-schematic OT data acquisition can be a challenge. In these cases, consider using industrial protocol gateways and industrial IIoT gateways to convert the data hidden in different industrial equipment, controllers and HMIs into a single data format for transmission and analysis.

Velocity

Facing the challenges from the so-called 'velocity' changes, focus on establishing a fully automatic OT-IT data circulation channel to reduce manual interventions. OT data can be continuously added through the three major stages of the process (display, analysis and feedback). The two most common issues to consider when establishing this cycle of OT data are:

- **Seamless conversion of IT/OT data streams:** For OT data to be successfully analysed by the IT system, a slew of background information, such as data source, data unit, data format and collection time needs to be provided. If this data isn't properly converted, manual intervention will be required, causing the system to lag.
- **Smart edge-cloud integration:** Use AI at the edge to resolve on-site issues in real time without relying on a cloud analytic system to come up with a solution.

Volume

Facing challenges from the so-called 'volume' changes, it is necessary to construct a high-speed and stable OT data transmission network. Two points should be noted when building this network:

Use data transmission technology with high bandwidth and a backup mechanism: Technologies such as 10 Gigabit ultra-high-bandwidth industrial Ethernet, time-sensitive networking (TSN), Wi-Fi 6 or industrial 5G, and other new-generation wired/wireless communication devices are recommended.

Manage the volume and flow of data: When dealing with the flow of large volumes of data, a unified, cross-unit OT data management platform or visualisation tool should be established to systematically store and manage the data. This will enable different departments to meet each other's data application requirements.

Veracity

Facing challenges from the so-called 'veracity' changes, it's important to first understand that there is no perfect solution for cybersecurity. Nothing is 100% secure. The only thing to do is to effectively reduce risks through good management. The following three aspects need your serious consideration:

Security comes from design: the strength of a system's security is predetermined at conception. Therefore, it is necessary to pre-emptively think about the situations where cyber attacks may occur, and when designing or updating a system, it is crucial to also incorporate the corresponding cybersecurity protocols.

Besides managing the security of the company's own system, many cybersecurity incidents are caused by the products or services provided by third-party suppliers. These suppliers could create vulnerabilities within the company's system by accident (for example, by providing computers containing ransomware).

Improving staff cybersecurity awareness and crisis management ability is also important. It is necessary to provide appropriate cybersecurity training for IT and OT maintenance personnel to improve awareness and avoid being the source of cybersecurity vulnerabilities.

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Devices of the ST H series can be configured with a permanent magnet incorporated inside the housing, able to generate a holding force between sensor and actuator. This way, the guard can be kept closed even where there are vibrations, after a recoil during closing, or in areas where air turbulence tends to open the lighter guards.

The magnetic holding force can be selected among from different magnitudes, in order to adapt to any usage situation. The symmetry of the housing allows the same sensor to be used on both left and right doors by simply rotating the sensor onto itself. The 78 mm mounting hole spacing facilitates the replacement of the traditional SR B magnetic sensors with an advanced RFID safety sensor.

The ST H series RFID sensor from Pizzato are compatible with all ST series actuators and are IP67 and IP69K rated allowing use in tough conditions.

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EMBEDDED SYSTEM

The Aaeon BOXER-6642-CML offers 10th Generation Intel Core i3/i5/i7/i9 processors with up to 35 W TDP. With up to 64 GB of DDR4 memory, the BOXER-6642-CML is said to ensure top end processing capability. While a 2.5″ SATA drive can be internally mounted for operating system and data storage, the system also features an M.2 2280 (M-Key) slot driven by PCIe 3.0 (x4) with support for fast NVMe SSDs. Additional expansion is provided by a M.2 2230 (E-Key) that supports a range of functions including Wi-Fi and Bluetooth connectivity and a full-sized Mini Card slot which can be configured via the BIOS to support PCIe or mSATA cards.

In addition, the BOXER-6642-CML offers a flexible range of I/O features including four serial RS-232/422/485 COM ports, four USB 3.2 Gen 2 ports and two Gigabit Ethernet ports with support for Intel vPro and Intel AMT, enabling remote monitoring and control.

A key feature of the BOXER-6642-CML is its low-profile industrial design. At only 54 mm in height, the system can fit into tight spaces, making it easier to deploy. The system also features a wide voltage input (10–35 VDC) and a wide operating temperature range of 0 to 45°C. The BOXER-6642-CML's fanless construction also keeps dust and other contaminants out of the system.

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AS I SEE IT

WHAT DO YOU NEED TO KNOW ABOUT DIGITAL TWINS?

Digital twins are the talk of the town. But when a new term shows up on the market, we have to ask ourselves is this term just a buzzword or is it something of value?

The digital twin is quite simple to explain; the idea is to create a digital duplicate in the cloud of a real thing such as a product, process or service. Then, with an online connection between the digital version and the physical device, it's possible to run analyses to predict health conditions and prevent potential problems.

Further, the digital twin allows the running of digital simulations, providing a chance to improve processes, prevent unscheduled downtime and much more. The digital twin is not a new concept, but it has become more popular with the new solutions that are appearing on the market using Industrial Internet of Things (IIoT) technology.

There is a broad range of possibilities for using digital twins in industrial applications. At the same time there are different implementations of digital twin technology. For instance, the digital twin can be created automatically when you have a connection between the field and the cloud using an edge device. However, it's also possible to create a digital twin of your device in a different way: for example, scanning the serial number, taking a picture or adding the information manually to the cloud using your smartphone.

The idea is to have a digital version of a physical device that automatically collects data from it during its operational lifetime. On top of that, it's possible to implement algorithms that understand the device performance, check its behaviour or provide relevant data regarding the plant's installed base.

For instrumentation on the plant floor it is possible to generate a digital twin for every asset. To do this, all devices are connected together (through a Profibus network, for example), and through an edge device make a connection to the digital twin cloud solution. When the connection is established between the IIoT cloud and the edge device, a digital duplicate is automatically made of each asset to the cloud. This ensures that all data is collected from field devices and a perfect copy is mirrored in the cloud.

Depending on the service implemented in your IIoT platform, the digital twin can be used in different ways, for example, to understand your installed base, to find obsolete devices or to make suggestions for improvements.

Smart instrumentation contains a wealth of information in addition to the measured value. It's estimated that 97% of the available data isn't utilised, but with digitalisation all the data in these devices can be easily accessed and analysed continuously. It's impossible to understand and interpret all this data manually — there is simply too much — but not utilising this data means you could be missing an opportunity to identify issues before they become a problem.

More and more, we're going to see services dedicated to solving daily problems that use cloud solutions. All the insights provided after the digital simulation are usually presented on dashboards making key data understandable and actionable. This further lessens costs often associated with hiring technical IT experts into existing teams and reduces workloads and complex training for existing personnel.

Stephen Flannigan is currently the Marketing Manager at Endress+Hauser Australia. He has spent over 30 years working in the industrial automation industry, having previously worked for Honeywell, Citect and Schneider Electric in a variety of different roles from engineering and project management through to sales and marketing.

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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

Publishing Director/MD
Geoff Hird

Art Director/Production Manager
Julie Wright

Art/Production
Colleen Sam, Krystyna Kappel

Circulation
Dianna Alberry
circulation@wfmedia.com.au

Copy Control
Mitchie Mullins
copy@wfmedia.com.au

Advertising Sales
Industrial Group Sales Manager
Nicola Fender-Fox – 0414 703 780
nfender-fox@wfmedia.com.au

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

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

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