PROCESS TECHNOLOGY

AUTOMATION + CONTROL + INSTRUMENTATION

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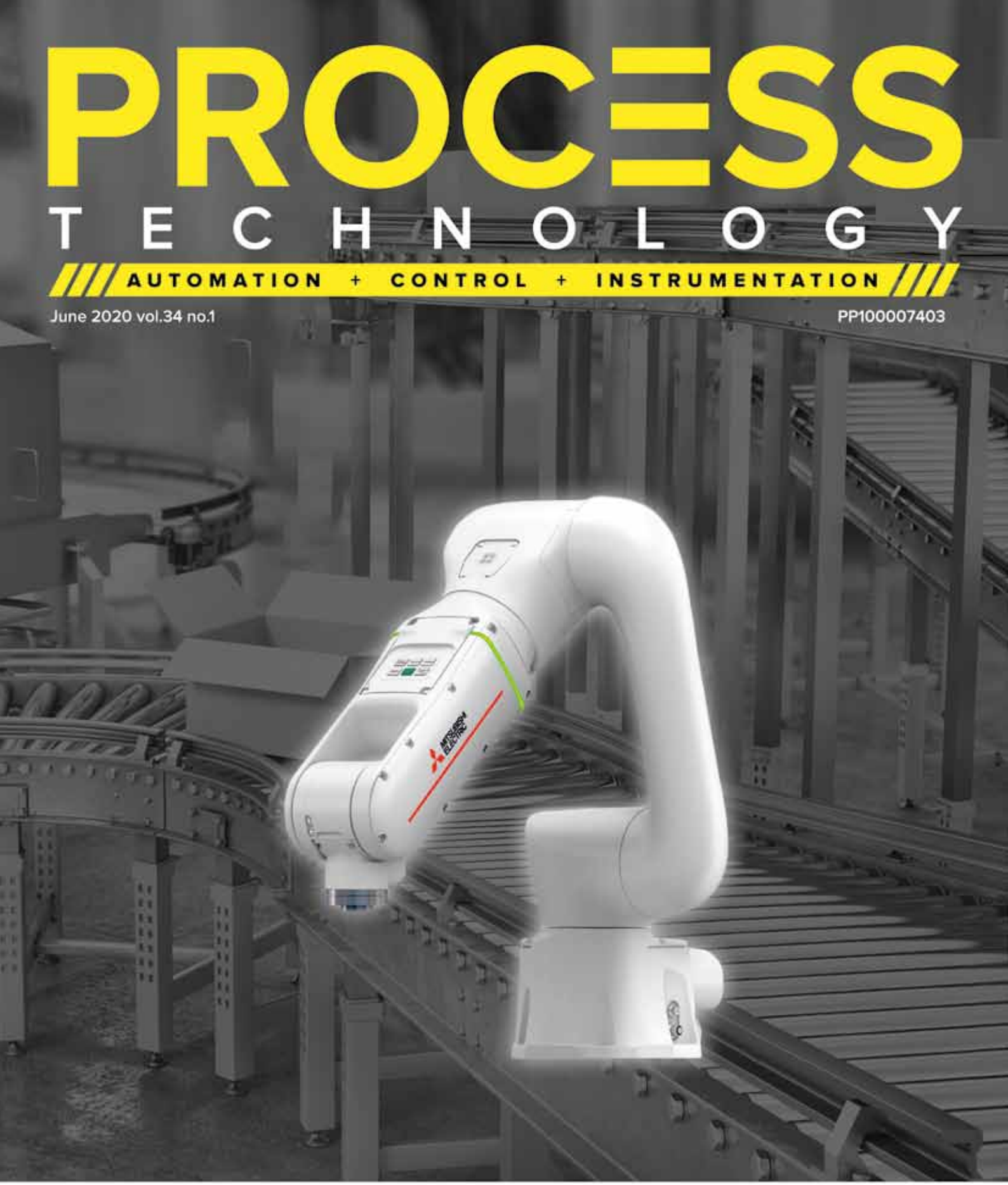

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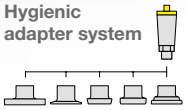

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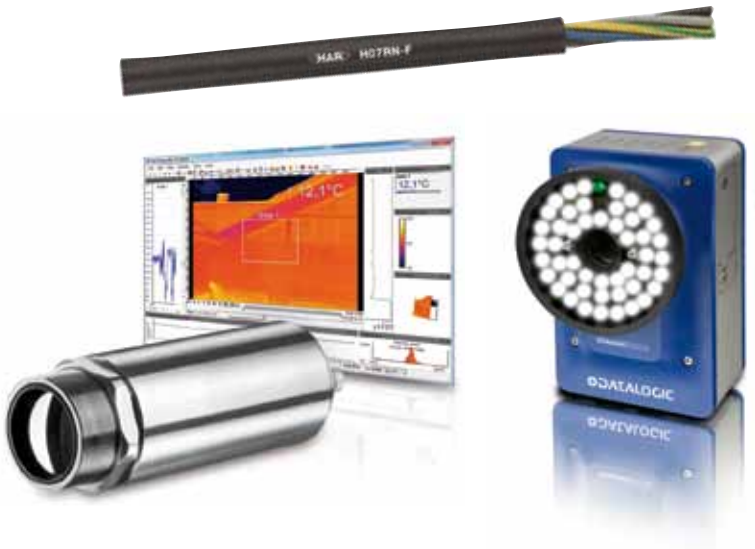

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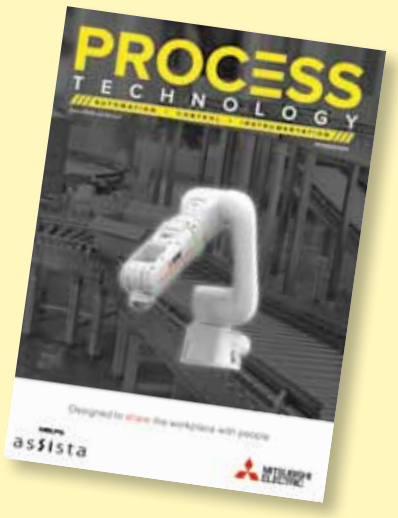

Mitsubishi Electric cobots are designed with safety as a priority. Compared with the traditional industrial robot, cobots are intended to collaborate and share the workspace with humans. They provide human operators greater flexibility, allowing them to do their job more efficiently.

Using the new PC programming software, RT Visual, the engineer can easily pick and drop the icon to program the movement of the cobot. The cobots can also be programmed via the operation panel on the cobot arm, making it much easier for the engineer to teach by hand and save the position through the operating panel on the cobot arm.

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MACHINE AUTOMATION AND ITS ROLE IN DIGITALISED MANUFACTURING

In the Fourth Industrial Revolution, the ability to see the potential of digitalisation and to separate the hype from reality will make the difference between success and failure.

The advent of a Fourth Industrial Revolution was first announced at the Hannover Messe in 2011. During that exhibition, the term 'Industrie 4.0' was coined by the German Chancellor Angela Merkel, to describe this revolution to come.

The first Industrial Revolution brought mechanisation to manufacturing, the second one electricity. In the 1970s, a third revolution further enhanced production processes with the introduction of information technology. The first three revolutions were all identified in the aftermath. Now, for the first time, Industry 4.0 describes a revolution before it happens, creating stimulus for its advent, rather than describing it afterwards.

Below is an excerpt from the final report of the Industry 4.0 working group:

"[...]the introduction of the Internet of Things and Services into the manufacturing environment is ushering in a fourth industrial revolution. In the future, businesses will establish global networks that incorporate their machinery, warehousing systems and production facilities in the shape of Cyber-Physical Systems (CPS). In the manufacturing environment, these Cyber-Physical Systems comprise smart machines, storage systems and production facilities capable of autonomously exchanging information, triggering actions and controlling each other independently. This facilitates fundamental improvements to the industrial processes involved in manufacturing, engineering, material usage and supply chain and life cycle management. The smart factories that are already beginning to appear employ a completely new approach to production. Smart products are uniquely identifiable, may be located at all times and know their own history, current status and alternative routes to achieving their target state. The embedded manufacturing systems are vertically networked with business processes within factories and enterprises and horizontally connected to dispersed value networks that can be managed in real time – from the moment an order is placed right through to outbound logistics."

Industry 4.0 will help factories to answer individual customer requirements, it will address the growing need for increased productivity and efficiency, but it will also address social needs: supporting interactive collaboration between humans and machines.

Overview of prominent digitalisation initiatives

Digitalisation will impact the entire business environment. We see many changes already on the consumer side, where smartphones and apps have disrupted long-established business ecosystems with unexpected value propositions and cost-saving potential. However, even in fully controlled industry ecosystems, Industry 4.0 is not a standalone phenomenon. The process of digitalisation has already enabled several successful usage-driven models outside Europe, such as the jet engine business of GE.

Several associations and initiatives around the world are focused on applied digitalisation. Among the most relevant we can mention:

- Industrie 4.0 – Germany
- Made in China 2025 – China
- Industrial Internet Consortium (IIC) – USA
- Smart Manufacturing Leadership Coalition – USA
- Robot Revolution Initiative (RRI) – Japan
- Industrial Value Chain Initiative (IVI) – Japan

In Germany, Industrie 4.0 is driven by strong governmental support and supported by the main industrial associations (ZVEI, VDMA and BITKOM) as well as academia (represented by the Fraunhofer society). Other initiatives take a different approach to digitalisation and have a different setup with regards to founding and governmental push (Figure 1).

It is important to understand the influencing factors for each initiative, in order to be able to judge their impact and future direction.

This article mainly refers to the Industry 4.0 approach to digitalisation. However, the principles presented here are applicable to digitalisation in general. Priorities and speed of implementation may differ from initiative to initiative.

The Fourth Industrial Revolution and the Internet of Things and Services

The first Industrial Revolution was marked by the introduction of mechanically supported processes in industry. In the second revolution, electrical power enhanced the productivity of our factories. In the 1970s the development of IT and factory

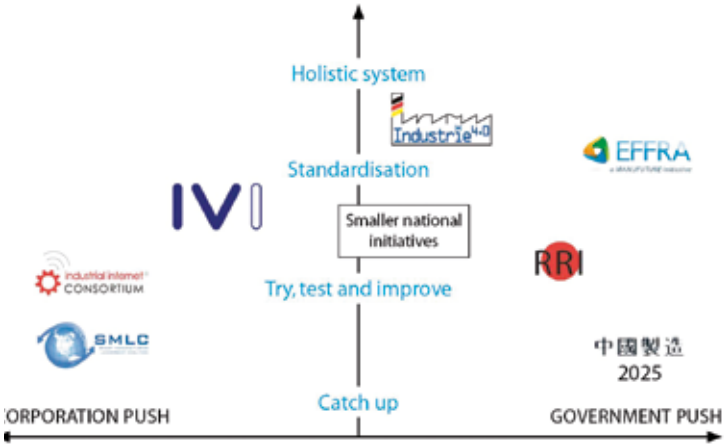

Figure 1: Digitalisation initiatives.

Figure 2: A physical device without digital connectivity can still be an Industry 4.0 component.

automation boosted industry into a third revolution.

The Fourth Industrial Revolution is characterised by a convergence of the physical world and the virtual one (cyberspace) in the form of CPS (cyber-physical systems).

This latest revolution has the potential for a more disruptive change than any previous industrial revolution. The pressure that this revolution brings to data processing requirements is making the traditional Moore's law inadequate to keep pace with current and future requirements, forcing the definition of new roadmaps for the evolution of processing power. The extent of this need can be easily imagined just by looking at the exponential growth of connected things.

This development forces all members of a supply chain, serving a particular segment, to consider how far they need to cooperate with partners, as well to consider how scalable business platforms can be created and leveraged.

Whenever talking of connected objects, it is important to understand that the Internet of Things (IoT) also includes physical devices that are not directly connected to the web or do not even carry any electronic intelligence. An object that simply makes its virtual representation available to an IT system can be considered an Industry 4.0 component.

As an example, we can consider a simple relay produced in a fully traced production process. If you associate this relay with a unique serial number and store it in a QR code, you can use this code to identify the relay. Scanning this code will show you when it was produced, where, how and on what route it was shipped to the customer (Figure 2).

This relay can be used in a fully digitalised production line, where its code is scanned when it is installed in the cabinet. Age, specification, life expectancy and supply route for replacement then become immediately available in the system.

WHENEVER TALKING OF CONNECTED OBJECTS, IT IS IMPORTANT TO UNDERSTAND THAT THE INTERNET OF THINGS ALSO INCLUDES PHYSICAL DEVICES THAT ARE NOT DIRECTLY CONNECTED TO THE WEB OR DO NOT EVEN CARRY ANY ELECTRONIC INTELLIGENCE.

In addition, the control system can record the operations and the load applied to the contacts to predict the remaining life of the relay at all times. When this prediction indicates an increased probability of failure, the system can automatically order a replacement. This replacement can be installed in the next maintenance cycle of the machine, avoiding unexpected downtime and production loss.

We can consider the above relay combined with its digital virtual representation as an example of a simple cyber-physical system (CPS) or the most simple type of an 'Industrie 4.0 component'[1]. Within Industry 4.0 terminology, this virtual representation is better known as the administration shell of the corresponding physical device (Industrie 4.0 component).

In a more complex reality, simple components like the one described above can be nested within more complex high-level components (for example, a machine or a whole production line).

If we now look at machines, lines or plants, we can recognise that we have a hierarchy of nested devices that build the system. The Industrie 4.0 component concept, together with its administration shell, has been defined to allow an easy and logical scalability of CPS (Figure 3).

The example of a simple CPS can be useful to also explain and clarify the real value of behind the IoT. The power of digitalisation is not in the data itself, in the connectivity or in the processing capabilities of a device. The real value of the IoT comes by using these cyber elements in order to make an object, a machine or a plant perform better.

Within a CPS, the combination of cyber and physical elements can transform a product into a 'smart product'. A smart product is a product that can perform a much more useful function with the empowerment provided by the IoT.

In a similar way, within the Internet of Services, large amounts of data can be processed autonomously in order to provide better and more useful services: 'smart services'. Examples of these smart services include predictive and preventive maintenance, made possible by processing large amounts of data collected from running products or machines.

The way forward to digitalisation

In 2014 PricewaterhouseCoopers released, in cooperation with VDMA and several industrial partners, a survey about the challenges and opportunities of the Industrial Internet[2]. This study clearly shows the extent of the commitment required by industrial organisations to properly implement the digital transformation. It also stresses how future customer satisfaction and related corporate success are closely related to this transformation process.

This requires an incremental and structured approach to digitalisation. Manufacturing strategy and company infrastructure must be transformed carefully and require a well-thought-out plan: a digitalisation strategy.

To conduct the transformation, several changes in the business environment must happen, especially to ensure efficient integration of relevant business partners in the horizontal integrated ecosystem. A network of reliable partners is a crucial element to succeed in this challenge.

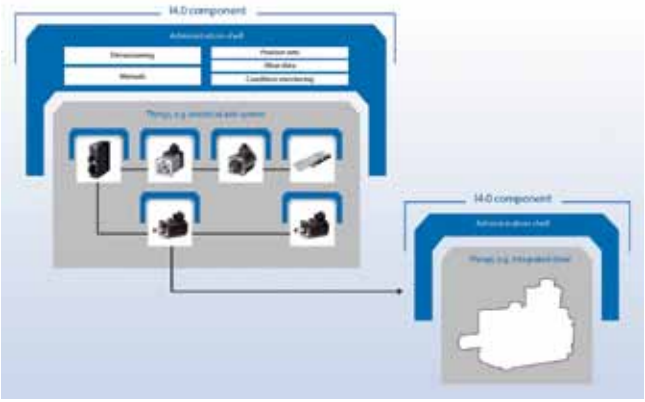

Figure 3: Industry 4.0 components.

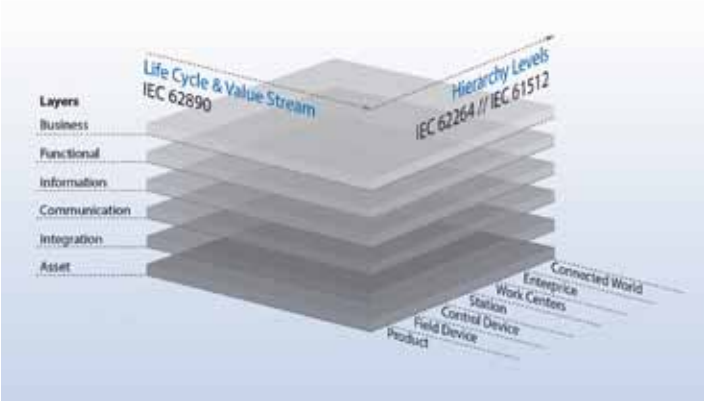

Figure 4: RAMI 4.0.

In a factory, vertical integration of communication is the key enabler to manage all the available assets and the relevant data. Vertical integration is enabled by a seamless communication infrastructure from plant level down to device level.

A proper digitalisation strategy must define all the key improvement areas and must set priority over the main value-added processes such as:

- Mass customisation, fast production changeover
- Full lifecycle traceability and single product serialisation
- Increased level of safety and security
- The management of a scarce skilled workforce
- Extensive machine collaboration
- Fast design and installation, reduction of production downtime
- Usage optimisation by condition monitoring and predictive maintenance

The Platform Industrie 4.0 has recently reconfirmed the research roadmap to be followed in order to achieve a full Industry 4.0 implementation.

This roadmap shows that a fully digitalised enterprise will not become reality before the 2030s, even if many technologies are already available to create and utilise digitalised production. A successful company cannot just wait until all the technology will be available, but it would also be wrong to surrender to the hype and get disappointed by too high expectations that cannot be matched.

The best approach involves starting the use of available technology to address the most value-added digital applications and to gradually move on through the digital journey.

Machine automation at the heart of digitalisation

The Reference Architecture Model Industrie 4.0 (RAMI4.0, Figure 4) was created in 2015 in order to cover all aspects of development and to define a model that embraces the entire enterprise, down to the level of a single device[1].

This model classifies all aspects of a digitalised production ecosystem. It consists of three axes addressing the most relevant dimensions:

- **The Layers axis**: Six layers define the structural composition of properties within a line or machine.
- **The Hierarchy Levels axis:** This axis, associated with the IEC 62264 and IEC 61512 hierarchy levels, represents functionalities within the plant or enterprises. To achieve a holistic view, 'Product' and 'Connected World' have been added.
- **The Life Cycle & Value Stream axis:** This axis represents the entire lifecycle of either products or plants, and uses IEC 62890 as a base. It has been amended by the definition of 'types' and 'instances' to enable a fully scalable use of the 'Industrie 4.0 component' concept.

The RAMI 4.0 full architecture is very powerful and very extensive; however, most companies cannot be expected to operate in the whole architecture. Partnerships need to be created across different players in order to achieve a full coverage of the whole architecture.

Successful implementation of digitalised production therefore requires multiple core competences combined in the manufacturer's ecosystem.

Machines are considered to be the core of production and, therefore, systems that enable machines to perform are the core enablers for the usage of smart data in production.

Another key factor in a digitalised production environment is a seamless vertical communication of sensor and machine data. Just as important as the vertical integration is the easy realisation of horizontal plant-wide integration, also supported by data communication technology, such as SQL.

Conclusions

The Fourth Industrial Revolution is just starting. The scalability of digital technology combined with the collective intelligence using emerging metadata sources promises a huge disruptive potential. But we have a massive hype at present and the expectation to get dramatic results in a short time may not be fulfilled.

The capability to see the real potential of digitalisation and the ability to separate the hype from the real enablers will make the difference between success and failure in any digital venture. But ultimately, the result will be systems that are:

- **Integrated:** Control platforms will be further integrated and they will support the highest scalability and reusability for machine usage.
- **Intelligent:** Smart Things will be connected to Smart Services, with outstanding analytics and data processing.
- **Interactive:** Smart design and usage will support engineers, maintenance staff and operators.

Recommended further reading:

1. Federal Ministry of Economic Affairs and Industry 2015, *Platform Industrie 4.0, Umsetzungsstrategie Industrie 4.0, Ergebnisbericht der Plattform Industrie 4.0*, «https://www.plattform-i40.de/PI40/Navigation/EN/Home/home.html»
2. PricewaterhouseCoopers AG 2014, *Industrie 4.0, Opportunities and challenges of the Industrial Internet*, «https://www.pwc.nl/en/assets/documents/pwc-industrie-4-0.pdf»
3. Kreutzer RT, Karl-Heinz Land K 2013, *Digital Darwinism*, Springer, Wiesbaden ISBN 978-3-642-54400-2
4. Karl-Heinz Streibich K 2014, *The digital enterprise*, Software AG, Darmstadt ISBN 978-0-09897564-0-2

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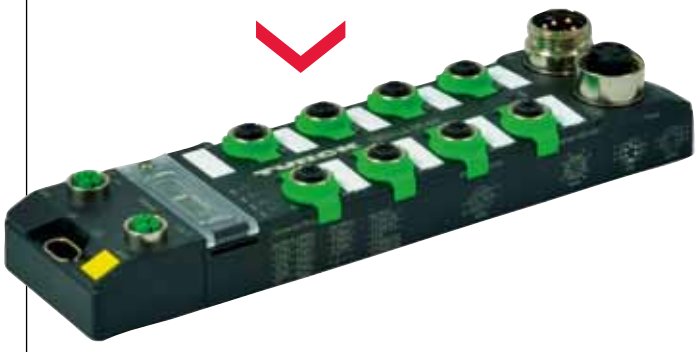

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Bonfiglioli drives large grain port project

Bonfiglioli recently partnered with Adelaide-based engineering firm Kilic Engineering on a large grain transportation project. Kilic Engineering is a diverse mechanical engineering company owned and operated by the Kilic family since 1973. The company has a long and proud history of excellence in designing, manufacturing and installing a very wide range of conveyors, material handling systems, chute work and associated structural elements.

With an established reputation built over years of operation in the industry, Kilic Engineering looked to a trusted supplier for this mammoth project. Danie de Vries, State Manager for Victoria, South Australia and Tasmania from Bonfiglioli, said that the initial challenge was local support.

"While Bonfiglioli is well established in both Australia and New Zealand — 31 years and counting — Kilic Engineering required ongoing local support and on-hand expertise for this project in South Australia. Thanks to our distributor network, we were able to make this happen through our partner Motion Control, in Adelaide," he said.

Craig Dennis, General Manager for Kilic Engineering, said that the application ultimately formed part of a large system for T-Ports. Established in 2018 with the $130 million Lucky Bay Port Facility development on South Australia's Eyre Peninsula, T-Ports specialises in innovative solutions for the export of commodities, using a flexible model that positions port infrastructure close to the product's origin. The name T-Ports is based on the use of transhipment vessels, reflecting the innovation central to the Lucky Bay project in moving away from the region's traditional port model.

Previously unseen in Australia for grain exports, the use of a transhipment vessel means T-Ports requires less than four metres of depth in the harbour, eliminating the need for major jetty structures and other port infrastructure. T-Ports transhipment technology is capable of operating in seas of up to 5-metre wave height and 30-knot winds. Due to the port being located close to the product, these facilities substantially reduce the road haulage distances, hence reducing the cost to government for road repairs and maintenance and reducing carbon dioxide emissions considerably.

The port of Lucky Bay itself underwent a harbour extension in 2014 and now incorporates two berth pockets for simultaneously loading or discharging two 87-metre or longer self-propelled self-discharging vessels.

The application required large amounts of grain products to be handled on a consistent basis. Grain is dropped into dual hoppers by trucks and is then moved into silos and finally into a large-haul shipping vessel via a boom conveyor. 1000 tonnes of grain needed to be transported per hour to a 24000-ton silo storage. Once ready for loading, the ship is loaded at a capacity of 13,800 tonnes per day.

"The boom conveyor is a long conveyor which goes from the land over to the shipping harbour and then into the ship," explained Dennis. "The locally fabricated Ahrens steel silos can be filled directly by trucks direct from growers or from the nearby bunker site via an internal haul road between the two Lucky Bay sites. The system design made in collaboration with our customer, Ahrens, includes belts, gantries, services, framework, conveyors, piling and concreted works and is based on 'off the shelf' solutions."

Handling facilities at the port have been designed to be competitive and efficient for the long term. They include a dual hopper which can facilitate two-truck simultaneous discharge of 1000 tonnes per hour.

Bonfiglioli supplied four conveyor drives and two bucket elevator drives for the project. All of these were locally designed and manufactured at their Sydney facilities. De Vries said that Bonfiglioli's gear motors were used to drive this large operation. "We used a series of HD and HDO heavy-duty gear units for this application."

Known for their high output torque, robust reliability and long operating life, Bonfiglioli's HD series is made up of high-quality materials and boasts an optimised design.

"The HD Series can operate in the harshest environments, as well as explosive atmospheres, with low maintenance costs and long service intervals," De Vries said. "Finally, drives can be customised thanks to an extremely wide range of options and a large accessories portfolio.

"We were able to deliver on time, on budget as per the scope. We are extremely grateful to Kilic Engineering for giving us the opportunity to prove our products in this application."

Bonfiglioli Transmission Pty Ltd

www.bonfiglioli.com.au

OPINION

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THE CHALLENGES OF IT/OT CONVERGENCE

In this age of cheap data and connectivity, businesses are increasingly utilising operational data to improve reporting for stakeholders or push the boundaries of efficiency. This may be achieved through data aggregation or utilising cloud-based analytics and machine learning platforms. Implementing these technologies ultimately involves integrating information technology systems with operational technology systems, otherwise known as 'IT/OT convergence'. While the benefits of collecting and utilising data will continue being realised for years to come, the convergence of these IT and OT systems presents immediate challenges for the teams that manage them, each of whom has different objectives.

IT teams are typically responsible for corporate networks, automating business processes, protecting information property and other financial and business documentation. The primary driver for the IT professional is to support and protect the confidentiality of the business and its employees.

OT teams maintain operational and industrial control systems (ICS), which drive processes that produce the product (or service) that the business sells. Downtime costs significant money and thus the primary driver for the OT professional is to maintain the availability and integrity of the system.

As IT/OT systems converge, the control systems within utilities, resources, manufacturing and infrastructure companies are becoming more connected than ever before and as such are at greater risk of cyber attack. Horror stories have circulated about oil pipelines and car manufacturing lines being shut down due to malware, worms and zero-day exploits. We also hear about poorly secured building automation networks being hijacked, resulting in hundreds of employees being unnecessarily evacuated and a loss of productivity.

Understandably, OT professionals are concerned about connecting to corporate IT systems given that most cyber breaches are unintentionally introduced by human error through USB devices, email phishing, poor password management or social engineering. In contrast, IT professionals are concerned about connecting to older, unsupported legacy OT systems or control networks designed with little consideration to cybersecurity.

The first step in developing a cybersecurity strategy should be to establish a risk profile for every part of the system. It may help to break this down into functional 'zones' and understand what network connections (or 'conduits') are required for that zone to operate. Protect these conduits using a technology that fits best, be it firewalls, access control list (ACL), an industrial security appliance or a data diode.

Sometimes the single biggest change one can make to an ICS network is to upgrade to managed switches. With managed switches one can control, segment and monitor the health of the network. Additionally, managed switches offer VLAN integration, redundancy and additional security features such as port locking so nobody can connect an unauthorised (and potentially risky) device to the network.

Consider also using change management software that has autosave and check-in features, which allow you to roll back any changes to ICS configurations, whether authorised or unauthorised. It is desirable for your change management software to be able to detect any unauthorised changes resultant of a potential cyber breach.

It is also important to understand that cybersecurity tools designed for modern IT environments may not suit a legacy ICS designed for a network of yesteryear. Consider, for example, an ICS that is end-of-life with known vulnerabilities that can't be patched and is too costly to replace. It still needs to be secured, and while investigating for vulnerabilities, if IT runs a port scan across the ICS network, it may lock up a PLC and shut down production for 24 hours. This situation can be avoided using passive scanning technologies that don't introduce new traffic on the network but instead inspect every packet of data. Tools are available that can detect and audit network assets, monitoring for configuration changes and anomalous behaviour, while mapping out the source and destination of all traffic. If there is data flowing to or from an ICS it can be identified and tracked.

A good reference point for developing an IT/OT security framework is provided by the Australian Cyber Security Centre (ACSC), which is introducing various guidelines and frameworks for our public services and critical infrastructure operators. Adopting the IEC-62443 zones and conduits concept is also highly recommended when securing an industrial control system network.

Irrespective of the technologies used when protecting a control system, it's important that the approach is collaborative between IT and OT teams. Be sure to work with vendors who have a multidisciplinary team, with expertise in both IT and OT environments, and who can offer training and support for the products they supply.

Kade Miller is a passionate technology and communications professional with over 11 years' experience in industrial networking, wireless telemetry, electronic engineering, Internet of Things (IoT) and data acquisition solutions. A cybersecurity enthusiast, Kade has further interests in data science and machine learning.

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In addition to the EtherCAT to Modbus RTU gateway function of the ECAT-2610, the -DW model can integrate smart meter slave devices into EtherCAT control systems through a special configuration file provided by ICP DAS. The EtherCAT master can access RxPDO and TxPDO to connect multiple smart meter slave devices such as the PM-3033/3133/3114/3112. It can achieve a more diversified energy management program.

The ECAT-2610(-DW)/2611 communicator can be used to connect non-networked industrial devices and equipment to an EtherCAT system. It allows serial-based RS-232/422/485 industrial devices and equipment to be easily integrated into an EtherCAT control system without the need to make any changes to the device. The ECAT-2610-DW is a DWORD version of ECAT-2610 that is suitable for smart power meters of the PM-3000 series, supporting up to six power meter connections.

The ECAT-2611 series provides a data exchange buffer that allows two different systems (EtherCAT Master and the Modbus RTU Master) to exchange data easily and faster for more diverse applications.

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

FOOD-GRADE SOFT GRIPPER

The OnRobot food-grade soft gripper is able to pick a wide array of irregular shapes and delicate items in food and beverage, cosmetics and pharmaceuticals production, as well as manufacturing or packaging.

The flexible electric gripper uses three interchangeable silicon-moulded cups in star and four-finger configurations to pick up almost any small object under 2.2 kg with a delicate, precise touch. It is food-grade certified (complies with FDA 21 CFR for non-fatty items and EC 1935/2004) and, unlike traditional vacuum grippers, requires no external air supply, so it can reduce both cost and complexity.

OnRobot's One System Solution is a platform that provides a unified mechanical and electrical interface between leading robot arms and any OnRobot end-of-arm tooling (EoAT). The One System Solution has been expanded to include integration with robots from ABB Robotics and Hanwha Precision Machinery.

While the soft gripper is suitable for food and beverage applications, it also provides flexible, delicate gripping for manufacturing and packaging. Grip dimensions ranging from 10 to 118 mm are possible depending on the cup used.

Scott Automation & Robotics Pty Limited
www.scottautomation.com

DEVELOPMENT AND SIMULATION TOOLS

MathWorks has introduced Release 2020a with expanded AI capabilities for deep learning. Engineers can now train neural networks in the updated Deep Network Designer app, manage multiple deep learning experiments in an Experiment Manager app, and choose from more network options to generate deep learning code. R2020a introduces capabilities specifically for automotive and wireless engineers in addition to hundreds of updated features for all users of MATLAB and Simulink.

The new release introduces an enhanced Deep Learning Toolbox that helps users manage multiple deep learning experiments, keep track of training parameters, and analyse and compare results and code with the Experiment Manager app. Users can also interactively train a network for image classification, generate MATLAB code for training and access pre-trained models with the Deep Network Designer app.

Additionally, GPU Coder now offers a more expansive set of networks to implement AI systems on cloud and edge devices, including Darknet-19, Darknet-53, Inception-ResNet-v2, NASNet-Large and NASNet-Mobile.

R2020a also includes three new products. Motor Control Blockset contains a library of motor control algorithms optimised for generating compact code as well as out-of-the-box support for multiple motor control hardware kits. Simulink Compiler lets engineers generate standalone applications, web apps and software components from Simulink models, enabling simulations to run without installing Simulink. MATLAB Web App Server offers controlled access from a browser to MATLAB web apps deployed across a user's organisation.

For wireless engineers, MATLAB support for 5G and Wi-Fi 6 technologies has expanded with additional support for waveform generation and cell detection.

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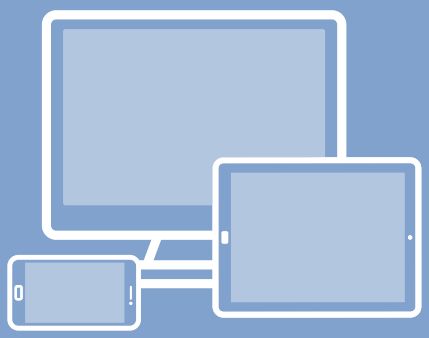
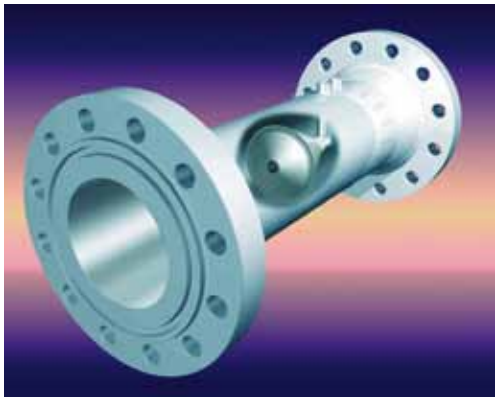


We make ideas flow.

bürkert
FLUID CONTROL SYSTEMS

NEW PRODUCTS



FLOW METER

McCrometer's V-Cone flowmeter is a differential pressure instrument that is suitable for use with liquid, steam or gas media in rugged conditions where accuracy, low maintenance and cost are important. The V-Cone is especially useful in tight-fit and retrofit installations.

The V-Cone is designed for today's most challenging oil and gas production, chemical, food and beverage, plastics, pharmaceuticals, district HVAC, textile, power, water and wastewater applications.

With flow conditioning built into its sensor design, its centrally located cone interacts with the fluid steam, reshaping the velocity profile to provide a stable signal that increases measurement accuracy. The pressure difference exhibited between the static line pressure and the low pressure created downstream of the cone is measured via two pressure-sensing taps, one placed slightly upstream of the cone and the other located in the downstream face of the cone itself. The pressure difference is then incorporated into a derivation of the Bernoulli equation to determine the fluid flow rate.

The V-Cone flow meter is available in flanged, threaded, hub or weld-end as standard with special connections available on request. It is said to offer better accuracy and repeatability, wider rangeability, installation flexibility and reduced maintenance.

AMS Instrumentation & Calibration Pty Ltd

www.ams-ic.com.au

COMPACT MANAGED SWITCHES

The Hirschmann Gecko 8TX and Gecko 8TX/2SFP managed switches offer four to eight fast Ethernet ports and the option for two Gigabit SFP slots to save space and cost while increasing bandwidth.

Updated features of the Gecko switches include VLAN support as well as the MRP protocol to complement existing RSTP support, and IGMP snooping for multicast control. Management and monitoring of the device has further been enhanced with the addition of an SNTP client for time synchronisation to ensure that the log files and information generated are accurate and useful. EtherNet/IP and Profinet industrial profiles can be used to easily integrate the device into the application.

These additions are said to make the GECKO switches a fully functional light managed switch, with a low-cost entry point, a small footprint and eco-friendly power consumption.

Control Logic Pty Ltd

www.controllogic.com.au

SUBMERSIBLE PUMP CABLE

The ÖLFLEX H07RN-F, Enhanced version, is a rugged rubber cable that is suitable for many robust and water-submersible applications. A special rubber sheath on the power and control pump cable, with improved submersible conditions, makes the LAPP H07RN-F Enhanced version suitable for use in industrial and agriculture use in long-time submersion down to 100 m without interruption.

The rubber sheath of the H07RN-F Enhanced is halogen-free and flame-retardant for industrial areas with a high density of people or valuable assets. The black rubber sheath also gives UV and ozone resistance up to +90°C. The cable is available in many variations from single-core to multicore and up to 16 mm conductor size and 185 mm conductor size.

LAPP Australia Pty Ltd

lappaustralia.com.au

CLOUD-CONNECTED RADAR LEVEL INSTRUMENT

Endress+Hauser has launched the Micropilot FWR30, its first cloud-connected radar, to provide full transparency in the storage and transport of liquids. Said to be the world's first 80 GHz wireless IIoT sensor, it combines industrial technology and user-friendly digital services in one device. The instrument's continuously recorded measurement data can be accessed at any time from anywhere due to the device's cloud connection, with communication made possible by an integrated SIM card.

Installation is easy and can be done in less than 3 min. An integrated battery allows operation without an external power supply — a particular advantage for measuring points that are difficult to access. The compact device is suitable for stackable tanks and enables a plug-and-play solution for flexible and easy installation.

In addition to the measured level, users receive information on the location of their storage tanks and containers via the cellular communication system. The instrument provides facts where previously only assumptions were possible, helping users optimise logistic and storage processes and save time by providing continuous and easy access to inventory information.

The product can be used for level measurement and inventory management of mobile and stationary plastic tanks. The free radiating measuring device covers measuring ranges up to 15 m and temperatures between -20 and +60°C.

Users can choose from a broad range of services that include Netilion Value and SupplyCare Hosting. All digital software applications can be used on various end devices and comply with security and data protection requirements.

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

AI INFERENCE PLATFORM

The Neousys Nuvo-7166GC-T4 AI inference platform features two PCIe slots that support an NVIDIA Tesla T4 inference accelerator to provide 8.1 TFLOPS in FP32 and 130 TOPs in INT8 for real-time inference based on a trained neural network model. Along with an Intel 9th/8th-Gen Core 6/8-core CPU and 64 GB DDR4-2666 RAM, it offers a balance between CPU, GPU and memory performance.

The system utilises Neousys's Cassette Module that has an air tunnel design to guide intake air to flow through the passive heat sink of Tesla T4 GPU. The Cassette Module is equipped with a second fan to deliver air flow for a second performance PCIe card installation. This cooling design provides operating temperatures of up to 60°C with sustained 100% CPU and GPU loading.

The system also incorporates an M.2 NVMe interface that supports fast disk access and USB 3.1 Gen2 and GbE PoE ports for data input. The Cassette Module also offers an additional Gen3, x8 link PCIe slot for installing a high-performance PCIe card or a variety of sensor or image acquisition cards.

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

A 'Tasti' solution for a snack manufacturer

Products manufactured by Tasti Foods can be found on most supermarket shelves throughout New Zealand and Australia. Operating for three generations, the company remains proudly New Zealand owned and operated. The company began life back in the 1930s when two friends decided to start producing crystallised ginger. Fast forward over 80 years and now a workforce of over 250 produce a wide range of food products including co-manufacturing for a number of internationally recognised brands. They also supply nearly every supermarket chain in New Zealand and Australia with private label snack bars.

Tasti has been in its current purpose-built facility on the Te Atatu Peninsula for almost 50 years. In that time the factory has been extended and refitted several times as the company has grown. This modern facility is fully automated and designed to deliver the highest quality products, and Tasti continues to invest heavily in the required plant and facilities to ensure it can operate efficiently and to the highest quality standards.

Compressed air is mainly used for the automation of equipment in the manufacturing process. Some of the most sensitive pieces of equipment that compressed air powers at Tasti are the sophisticated robotic packing machines. Here, compressed air powers a number of critical tasks: from picking and making boxes, to placing the products in the boxes, and sealing the boxes ready for dispatch. The equipment operates very quickly — it is able to pack over 800 products a minute — however, to do this it relies on a constant supply of high-quality dry compressed air.

The existing compressed air system was struggling to reliably and efficiently meet requirements. Recurring failures in the compressed air line were creating downtime in some areas of production. At the same time as these issues were occurring, Tasti had begun planning the expansion of its facility to include a new hall specifically to manufacture its burgeoning wholefoods 'free from' product range.

As Tasti started the planning process for the new build, elevated electricity bills had also led them to invite Energy NZ to conduct an audit on the existing facility. One area the audit highlighted was that cost savings could be made by investing in compressors that were connected through a controller to each other, and were well staged. As the facility had developed over the years, so had the compressed air system grown and changed, and the existing compressors were therefore not linked together and had no staging control. There was also no ring main connecting all compressed air applications in the facility together to one compressed air source.

All of these factors together led Matthew Barber, the Maintenance, Engineering and Environmental Manager at Tasti, to take the new build as an opportunity to address the entire compressed air system for the facility.

"We saw the expansion as the ideal opportunity to find one solution that would not only solve the issues we were having with the existing compressor system, but would also allow us to get the whole plant set up on a ring main from one central compressor room," he said. "In addition, we were keen to digitalise the compressed air system — linking all of the compressed air equipment together for optimum efficiency and system control."

Barber invited a number of compressed air providers to review their requirements and recommend a solution. Kaeser Compressors was one of those invited to tender for the project and was successful in meeting Tasti's criteria. As a result, a complete Kaeser system was installed, as well as a ring main that now connects all of the compressed air applications throughout the facility to the new system.

The system consists of three Kaeser ASD series rotary screw compressors alongside a complete air treatment package that includes two TD series refrigeration dryers. For control and digitalisation, the entire system is controlled and managed by a Kaeser Sigma Air Manager 4.0 master controller.

For Tasti, incorporating the Sigma Air Manager controller enabled the company to have control of the entire system. The Sigma Air Manager utilises adaptive control to make air generation and treatment more reliable and efficient. By predictively calculating and comparing various operating scenarios, it selects the most efficient settings to suit Tasti's specific needs at any one time. Compressor flow rate and energy consumption are therefore always optimally matched according to actual air demand. In combination with the integrated multi-core processor industrial PC, the adaptive control is able to ensure optimised performance for Tasti at all times.

Now up and running, the new Kaeser system is delivering a reliable, efficient and high-quality source of dry compressed air throughout the facility.

"The new Kaeser compressed air system has helped us solve a number of issues," Barber said. "The SAM 4.0 in particular has allowed us to develop a fully connected compressed air system, giving us a lot of control over, for example, our energy usage."

Kaeser Compressors Australia
au.kaeser.com

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A BETTER WAY TO CALIBRATE

www.beamex.com
info@beamex.com

Beamex MC6-T

New revolutionary temperature calibrator

AMS

The Beamex MC6-T is an extremely versatile portable automated temperature calibration system. It combines a state-of-the-art temperature dry-block with Beamex MC6 multifunction process calibrator and communicator technology.

With the ability to generate temperature as well as measure and simulate temperature and electrical signals, it offers a really unique combination of functionality. In addition to temperature calibration abilities, the MC6-T also offers electrical and pressure calibration capability, all in one device.

It offers versatility, that no other temperature calibrator can match.

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CHALLENGES IN THE MAINTENANCE OF COMPLEX PLC-DRIVEN SYSTEMS

PLCs are now widespread in process control and automation systems and there is a trend towards increased complexity of such systems. The increased amount of information about processes leads to their improvement and increased efficiency, but it also leads to increases in PLC code size and complexity. Consequently, commissioning and maintenance of such systems is often a real challenge. In all but the simplest installations, there is a frequent need to synchronise operation of a number of PLCs — actions taken in one part of the system affect actions that the rest of the system may need to take. PLC programs never shrink in size — almost any code modifications increase the code size. The more complex a system, the more difficult it is to predict and later identify all the side effects of any code changes.

The trends described above lead to three major problems that control engineers face:

1. Verifying correctness of system operation at the commissioning stage and then locating and fixing any issues that often emerge in both the startup phase and in early operation of a system.
2. Managing changes to PLC code in running installations, detecting any side effects resulting from the changes.
3. Identifying the sources of any system malfunction as systems age and wiring, sensors and actuators operate less reliably.

In many cases control systems problems have the form of 'gremlins' — sporadic faults appearing and disappearing seemingly at random. It may be a matter of PLC code running 'off the rails' due to a randomly misbehaving sensor or an unreliable electrical contact. It may be that the code which works as intended suddenly fails because it does not handle certain external events occurring in a particular sequence or at particular times. Causes for such intermittent and often very short-lasting faults are notoriously hard to identify. This is the worst kind of problem a control engineer may face, and while tightly monitoring the system 24 hours a day may allow to catch the glitch sometimes, it does not always work and is always expensive.

Another problem is that maintenance of a system often involves making changes to the PLC code written by somebody else in the past. If the code is sufficiently complex — and it often is — making such changes necessitated by system modifications or required by the end user is fraught with risks. It may be very difficult to predict what a change can lead to in terms of side effects.

Introducing PLC-Analyzer pro 6

The German company AUTEM offers PLC-Analyzer pro 6 — software with unique ability to assist in tracking and diagnosing PLC-related problems. PLC-Analyzer is a purely software solution: no additional hardware is required. It can connect to multiple PLCs at the same time, monitor their internal tags and record them with no need to change or add to the PLC code. PLC-Analyzer can be connected to a PLC via its programming interface and

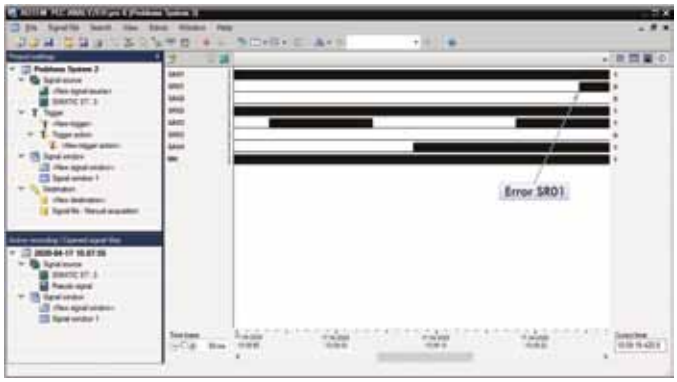

Figure 1: Diagnosis of sporadic faults with PLC-Analyzer.

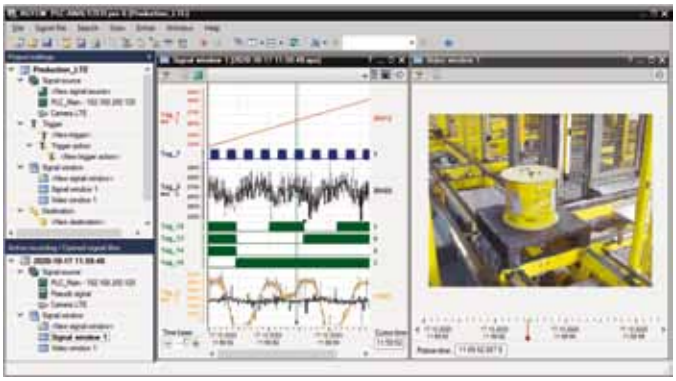

Figure 2: Troubleshooting with video support.

also, if the PLC supports it, via Ethernet or the Internet. Multiple PLCs, possibly of different types, can be simultaneously monitored in real time in the same window.

All values monitored by PLC-Analyzer can be recorded and subsequently re-played onscreen. Recorded data is accurately timed and the timing information can be easily retrieved. Project files can be used to automate frequently recurring acquisition sessions.

Additional hardware supplied by AUTEM enables the monitoring of actual physical signals, both analog and digital, independently from the PLC, and these signals can be displayed in real time in the same window as internal PLC tags. This helps to detect situations where there is a discrepancy between the actual physical values and the information used inside the PLC code.

Figure 3: Correlating signals at different locations in the system.

Recording of timed data coming from possibly a number of PLCs also facilitates the optimisation of the process, leading to material and energy savings and increased plant efficiency.

Recording of values and timing of process data, taken at different times during the life of an installation, enables the detection of process changes due to equipment ageing or changes in raw materials.

PLC-Analyzer pro 6 supports the definition of trigger conditions to intercept intermittent, randomly appearing events. A trigger, when activated, saves the pre- and post-event data and can also send an SMS message or an email.

In systems with robots or moving machinery, it is sometimes difficult to investigate cases where the machine movement seems to be taking place in an incorrect way or at an incorrect time. It is possible to connect a video camera to the PLC-Analyzer and obtain simultaneous recordings from the camera and recordings of internal tags in PLCs. Analysis of such recordings can show what is the nature and, most importantly, the cause of incorrect equipment behaviour.

Records of information internal to the process, made by software not related to the manufacturer of the plant equipment, PLCs or to the developers of PLC code may assist in resolving warranty claims. In any dispute an independent 'second opinion' is always of benefit.

Supported PLCs

The PLC-Analyzer supports the following PLC families:

- Siemens S5, S7 and related models
- Beckhoff TwinCat family
- B&R PLCs
- Pilz PSS and PNOZ controllers
- AllenBradley ControlLogix and Compact PLCs and SLCs
- Phoenix Contact PLCs
- Bosch CL family of controllers
- GE Fanuc Series 90, VersaMax, Nano, Micro, CNC and PMC
- Fanuc R30i and R-J3i
- Omron C, CV, CS1, NJ, NX, NY and CJ2
- Mitsubishi MELSEC Q, L, A, and FX
- Schneider Modicon TSX Quantum, Momentum, Premium and Atrium
- Schneider AEG TSX A250, A120 and Micro
- Selectron
- Jetter JetControl, Delta and Nano
- Hitachi H, EH150 and Micro-EH
- all PLCs based on CoDeSys software.

PLC-Analyzer supports current as well as legacy PLCs. For many of these PLCs the software originally supplied by the manufacturer may no longer be maintained and may not be able to offer the monitoring, recording and fault capturing required by engineers today. Even if a manufacturer's software includes tracking and capturing capability, PLC-Analyzer users report that its functionality is superior to what native PLC-related software provides.

Conclusions

PLC-Analyzer pro 6 is an indispensable tool for system integrators to help at the commissioning stage. For companies with sophisticated automation and process control systems, it offers a means to resolve PLC-related problems as they arise, to optimise the processes and to monitor the systems for changes related to ageing of the machinery, and for condition monitoring.

Companies offering services in the area of PLC programming and code maintenance should make sure that the PLC-Analyzer pro 6 is included in their engineers' toolboxes. And if a system involves legacy PLCs, there may be no software available for advanced troubleshooting: here PLC-Analyzer pro 6 is indeed an indispensable engineering tool.

For more information please email: sales@fieldbus.com.au

fieldbus specialists

Fieldbus Specialists

www.fieldbus.com.au

MODULAR GATE BOXES

The latest version of the Euchner MGB Multifunctional Gate Box allows users to design protection for guards that meets their individual requirements. The MGB2 Modular and the MGB2 Classic offer more variations, additional functions, different networking options and intelligent communication features for IoT applications.

The MGB2 Modular comprises a locking module incorporating submodules with control and display functions and a bus module for connecting to Profinet/PROFIsafe. The guard locking submodules can be equipped with control elements such as push-buttons, selector switches, key-operated rotary switches or emergency stop buttons as needed. Two additional submodules allow users to integrate up to six different control elements in the locking module. The control elements can be replaced at any time during operation because the MGB2 Modular is hot pluggable. The MCM extension module can expand the MGB2 Modular's functions further by adding up to four more submodules.

The MGB2 Classic version has a modular design just like the MGB2 Modular and the locking module submodules can also be fitted with individual control elements. Unlike the Modular variant, the MGB2 Classic version does not communicate via a bus system but is instead linked directly to the relevant control system. It is therefore a suitable solution for non-networked parallel-wired installations. The system features two OSSD outputs, provides continuous diagnostic information via an LED indicator, and can be connected in series with up to 10 devices.

Treotham Automation Pty Ltd
www.treotham.com.au

DISTRIBUTION BOARDS

Consistent with the 'DB' family of distribution boards, the newly released DB Essential from APS Industrial is custom designed for the demands of Australian industry and purpose built for compatibility with Siemens circuit breakers.

The DB Essential has been developed as a quality lightweight distribution board for high-end commercial and medium-duty industrial environments. The enclosure by KATKO has a fully welded construction and meets the highest IK rating against external mechanical impacts while maintaining an IP55 ingress rating.

Together these ratings make this range of distribution boards suitable for indoor and outdoor applications.

While the DB Essential does not offer a removable gear tray (as featured in the DB Ultimate), the DB Essential offers flexibility in equipment options due to careful design considerations and a range of features such as a dual quarter-turn locking system, a removable hinged escutcheon and door, and a continuous poured door seal. These features are complemented by a galvanised gear plate, dual earth neutral bars and a removable gland plate at the top.

APS Industrial
www.apsindustrial.com.au

MACHINE VISION COMPUTER

System performance plus reliability are critical factors for vision-based systems. In order to detect defects, vision systems need to perform fast and accurate analysis of objects. The Aplex AVS-504 is powered by 7th generation Intel processors to provide a multi-core processing platform with high-speed PCIe x16 expansion. High bandwidth GPU data access is essential for reliable image processing performance.

The AVS-504 is equipped with two SODIMM sockets supporting up to 32 GB of DDR4 system memory, two Gigabit RJ-45 ethernet connectors, four USB 3.0 ports, two USB 2.0 ports, four digital inputs, four digital outputs, two RS-232 ports and one RS-232/422/485 and one RS-422/485 port for communication. Two easily accessible 2.5″ SATA hard drives can be internally mounted for operating system and data storage.

Two full-size Mini-PCIe slots are provided on the motherboard, and the AVS-504 is also available with two or four expansions card slots. Various PCIe x16, PCIe x4, PCIe x1 and PCI slot combinations are available.

The onboard Intel HD graphics engine provides VGA and HDMI output with support for 4K UHD high-resolution displays. The AVS-504 is also capable of connecting to multiple GigE and USB 3.0 cameras. The AVS-504 also supports light source control ensuring that objects are correctly exposed during the imaging process.

Possible applications include automation control, 2D/3D measurement, surface inspection, PCB inspection, robotic arm guidance, textile inspection and label/barcode scanning.

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

NEW PRODUCTS

UNIVERSAL PROCESS CONTROLLER

Hanna Instruments has launched the HI510 Universal Process Controller. The HI501 is an advanced universal process controller that can be configured for many applications requiring monitoring or control of process parameters. The controller features a digital probe input that will automatically detect and update the meter with the parameter that it measures. The HI510 offers wall, pipe and panel mounting options.

The HI510 is designed to adapt to a user's specific process control requirements. The meter has a large backlit dot matrix display for easy viewing and provides for an intuitive interface for set-up options. The controller utilises multi-colour LEDs for easy viewing of the instrument's status, including relay activation, alarm mode or hold status.

All programming operations are done through the low-profile vulcanised rubber keypad or with an RS485 connection to a PC running the HI92500 Windows-compatible software.

Hanna Instruments Pty Ltd
www.hannainst.com.au

DRIVE-INTEGRATED SAFETY MODULE

ABB is providing integrated safety functionality for its all-compatible variable speed drives (VSDs) to simplify the engineering design process in machine manufacturing and automation. The plug-in PROFIsafe module (FSPS-21) removes the need for external safety components and reduces the need for configuration.

The FSPS-21 enables safe machine control and seamless safety communications between the drive and the PLC in a wide range of machines from conveyors to grinders. This is enabled through the PROFIsafe over the Profinet I/O communication protocol.

The module allows for control, safety and PC tool communication to the drive through one Ethernet cable, which simplifies installation and commissioning. The module simplifies commissioning because it requires no additional safety configuration in the drive and moreover reduces the need for training.

The FSPS-21 module is TÜV Nord certified and is compatible with ABB ACS380 machinery drives, ACS580 general-purpose drives and ACS880 industrial drives. The module offers Safe Torque Off (STO) and Safe Stop 1-time controlled (SS1-t) safety functions. It achieves SIL 3/PL e and is therefore suitable for demanding applications.

ABB Australia Pty Ltd
www.abbaustralia.com.au

LOCAL VALVE CONTROL SOLUTION

The Rotork Local Hand Station is an actuator control panel optimised to control actuators or field devices located in difficult-to-access areas. It is suitable for applications such as large penstocks, where it is difficult to access the actuator due to height, in chamber applications where the actuator is located below the ground and space is limited, or for control when the actuator/device may be in a hazardous location.

Reliable local control is essential in many applications and the Local Hand Station provides a simple control panel interface between the actuator or field device and the DCS. It offers complete local override of DCS control signals to ensure localised maintenance activities can be performed safely without unexpected operation occurring.

Absolute control is critical to site safety so in addition to an Emergency Shutdown (ESD) button, the rotary selector switches have been used due to their increased resistance to sticking or jamming and the Local/Stop/Remote selector can be locked in any position.

The Local Hand Station can be pole or wall mounted and is ATEX and IECEx certified. Power can be supplied directly from the connected actuator, meaning that installation can be carried out with just a standard electrical cable. This prevents the need for any supplementary power supplies onsite.

Rotork Australia
www.rotork.com

DATA SENSING GATEWAY

Powered by an Intel Atom E3815 processor and featuring three configurable COM, two LAN (one PoE), eight programmable GPIO, one HDMI and one USB 3.0, the UNO-420 provides a solution for connecting legacy equipment to mesh networks. Suitable for harsh industrial environments as well as limited space applications, the UNO-420 has a compact form factor and supports a wide operating temperature range of -20 to 60°C.

Enabling remote infrastructure management, the device supports Wi-Fi, 3G, 4G/LTE and NB-IoT wireless modules that facilitate long-distance data transmissions, over-the-air updates and real-time communication. The UNO-420 is also embedded with a Trusted Platform Module 2.0 that provides security for cloud-based data operations. The UNO-420 adopts a PoE-In design that allows the terminal to be powered via a LAN port, reducing wiring and minimising maintenance costs.

Featuring Advantech's WISE-PaaS/EdgeLink protocol-conversion software, the UNO-420 supports more than 200 communication protocols, enabling data collection from legacy devices. It allows user-defined data acquisition periods for each input interface, reducing the volume of data transmitted and stored in the cloud. This combined with the software's plug-and-play functionality reduces programming, streamlining application development and deployment.

Advantech Australia Pty Ltd
www.advantech.net.au

DON'T GET CAUGHT WITHOUT A CYBERSECURITY STRATEGY

The need for a solid cybersecurity strategy has been discussed and debated for 50 years and yet the basic worm-type attacks first documented in 1972 are still with us today. Why? Because even the most basic measures to protect control systems from these types of attacks are still not systematically employed.

It's hard to believe there are still thousands of systems in operation today without any basic security controls in place. If you own a car, a house or a boat — just about any 'big-ticket'

item that would be expensive to replace — you protect that asset with insurance. Even though you can't see it or feel it, you know, instinctively, it's worth the money. You sleep better at night knowing you have it and it would be a high-priority item to reacquire if you lost it — especially if it contributed to your livelihood. But, when it comes to control system cybersecurity, this thinking, for some reason, is often not applied. Cyber experts are still struggling to convince senior management to spend money to protect their control system assets.

Recent events should be setting off alarm bells in boardrooms across the industrial world. Two viruses, WannaCry and NotPetya, have wreaked havoc on companies that were running older Microsoft Windows operating systems but failed an entry-level cybersecurity test: keep your systems patched and up to date.

Both of these viruses were destructive. WannaCry was standard ransomware, but NotPetya was a wiper bug masquerading as ransomware. Its purpose: cause maximum damage to the systems it infected. It forced thousands of large complex operations in many industries to halt production by scrambling data and offered no way out (such as paying for the decryption keys) to its victims.

Impacted companies have disclosed the financial impact of these attacks. It's not pretty:

- One of the world's largest container shipping companies, with substantial oil and gas assets as well, wiped as much as $300 million off its books in the third quarter of 2017.
- A skin-cream maker lost $41.5 million in first-half sales.
- A French building materials manufacturer said it lost about $280 million in sales in 2017.
- The worldwide pharmaceutical production of a major drug producer was disrupted to the tune of $670 million in 2017.
- A major international package delivery company announced a loss of $400 million.

That is a lot of money — over $1 billion in total — money that could have refreshed legacy systems, acquired new assets, invested in R&D, paid employee bonuses, delivered stockholder dividends, etc. Certainly some of it should have been spent hardening these organisations' systems against such events. So why wasn't it?

Why companies don't invest in cybersecurity

Part of the answer is pretty simple: it's hard to convince companies to spend money on something that has no measureable return on investment (ROI). Basically, it's hard to put a dollar value on an event that may not happen.

Of course, everyone knows cybersecurity is important and falls into the general category of risk management. But, as an event such as the massive oil spill in Alaska's Prince William Sound in 1989 proves, the cost of doing nothing is far greater than the cost of being proactive. Super tankers are now made with double hulls to prevent a repeat of that ecological disaster.

It isn't that control system owners don't deploy cyber and security solutions; they do. They are aware of the problem and take actions to avoid risks. But many in the industrial world are still too focused on the big attack or hack — the nation state that blacks out an entire region or shuts down the water supply to a city — when the bigger and more likely risk is common malware that impacts a control system because it is running older, unprotected and unpatched operating systems.

This risk exists even if the system is air-gapped from the business network. People often introduce data and software from removable media such as USB drives, exposing their systems

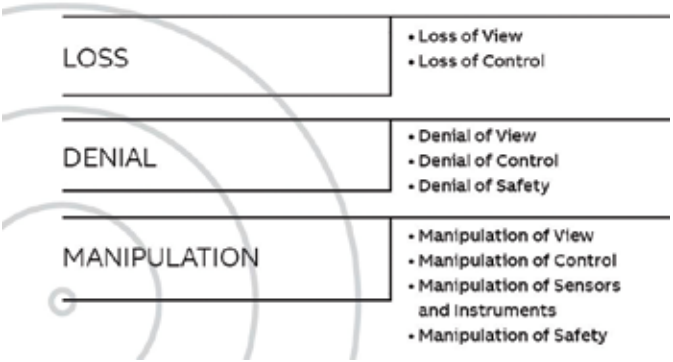

Figure 1: Attacker objectives.

to the potential for viruses along the way. As these air-gapped systems become more interconnected to enable integration with business applications, they become increasingly exposed to the internet. As we've seen in the past with WannaCry and NotPetya, this is why it is far more likely common malware will cause the most damage in the long run.

There is a fundamental disconnect in securing operational technology (OT) versus securing information technology (IT). But, as OT becomes more exposed to the internet, it faces the same cybersecurity threats as any other networked system. This is because operators have adopted the same hardware, software, networking protocols and operating systems that run and connect everyday business technologies, such as servers, PCs and networking gear.

At the same time, many machines and legacy systems are so old and proprietary, no self-respecting cybercriminal would ever write malware to attack them. Why? There just aren't enough of these systems around to make it profitable (typically the main motive of hackers everywhere today) or notorious (if they have more harmful motives).

That leaves control system operators in a tough position. If they try to deploy the same security measures as IT then a) they may not work or b) IT security measures, when effective, may actually shut down a running production process. This could be more harmful for the business than the cyber attack.

The problem is that IT cybersecurity solutions tend to focus on locking down data when there is a threat. That makes sense

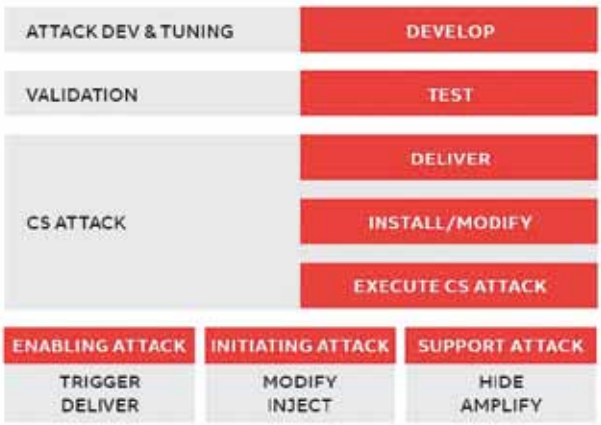

Figure 3: Stage 2 - Control system attack development and execution.

Figure 2: Stage 1 - Cyber intrusion, preparation and execution.

if it's a credit card database, but it doesn't work so well if a firewall blocks programmable logic controllers (PLCs) from opening and closing valves in an oil refinery or pulp mill.

Relying on luck is not a strategy

And then there is just human nature. Many operators simply rely on wishful thinking that goes something like this: "We haven't had an incident; therefore, we must be doing the right things." Well, not really. If you assume not having been attacked or hacked means you are doing enough, think again. You could just be lucky. Being lucky is great, but you should not rely on luck as a strategy. Talk to a professional gambler and they will tell you eventually luck runs out.

So how do you know the difference between luck and "doing the right things"? Ask yourselves the following questions. If you answer "no" or "don't know", then perhaps you should consider yourselves "lucky" and start taking a hard look at your cybersecurity posture and policies:

1. Do you regularly train your employees on cybersecurity best practices?
2. Do you have a comprehensive list of cyber assets?
3. Have you performed an operational risk assessment?
4. Have you performed a cybersecurity assessment?
5. Have you implemented proper network segmentation?
6. Have you implemented end-point malware prevention and do you update the signatures on a daily basis?
7. Do you patch your systems on a regular basis (minimum quarterly, ideally monthly)?
8. Are you monitoring your system logs and network traffic?
9. Do you have a backup of all your assets, such as switches, routers, firewalls, PLCs, RTUs, intelligent electronic devices (IEDs) and every other digital control asset with a configuration file?
10. If your system were compromised today, do you have a recovery and response plan ready?

If you answered "no" to one or more of these questions, you are not alone. Most control system owners do not employ this level of cybersecurity readiness. But, at a base level, if you do not have proper network segmentation, updated system software, end-point protection and hardened systems, then you are probably lucky that your system hasn't been compromised already.

Getting up to cyber speed

When thinking about how to get started, don't just look for some new technology that claims to mitigate all your risks — it doesn't exist. Doing the basics well before investing in advanced cyber technologies is the key. In order to minimise your risks and get the most protection in the least amount of time, you first need to plan and develop a cybersecurity program that:

1. Identifies what assets you are trying to protect.
2. Determines how you are going to protect those assets.
3. Enables intrusion detection and monitoring.
4. Defines incident response processes and procedures.
5. Verifies mechanisms to restore and recover assets.
6. Ensures compliance with all regulatory standards set by local governing bodies.

These six steps follow well-trodden ground. All cybersecurity best practices frameworks can be distilled into these basic steps: identify, protect, detect, respond, recover and comply.

For example, putting in a firewall to separate your control system from the corporate/business network is a great idea. But, if you don't have an inventory of critical assets and applications, you may still be vulnerable to risks from employees and contractors who use laptops and removable media. Developing strong security policies and practices, and mapping out a three- to five-year journey that leads to security maturity is also highly recommended.

> WHEN THINKING ABOUT HOW TO GET STARTED, DON'T JUST LOOK FOR SOME NEW TECHNOLOGY THAT CLAIMS TO MITIGATE ALL YOUR RISKS — IT DOESN'T EXIST.

Some effective technology tactics to consider are hardened perimeters, adopting a defence-in-depth approach, whitelisting, investing in a network intrusion prevention system (IPS), air-gapping control systems and security awareness training for all employees. Also, make sure to include specific contractual language about cybersecurity in your OT/control system requests for proposals (RFPs). To execute your plan, leverage your IT and OT teams, but also look for OT suppliers who can offer comprehensive cybersecurity services.

Conclusion

The list of things you should do to protect your operational technology is long and beyond the scope of this article, but if you continue to do nothing, imagining that your systems are safe from attack, it is only a matter of time before you won't be imagining — eventually, your luck will run out. Don't let it be your systems that go down this time, or your company that ends up in the headlines.

ABB Australia Pty Ltd
www.abbaustralia.com.au

DATA LOGGING PROBES

The latest KELLER CTD (conductivity, temperature, depth) versions of the DCX level data loggers for depths of up to 200 m are designed for long-term monitoring and can store over 50,000 time-stamped level measurements, as well as associated conductivity and temperature readings. The multipurpose probes have a diameter of 22 mm, making them suitable for sounding tubes with a diameter of 25 mm or greater.

The integrated measuring systems are suitable for checking the ingress of seawater, slurry or fertiliser into groundwater, rivers and lakes, or for performing observation tasks relating to building projects or localised water pollution. The Series DCX-22 CTD level probes with integrated data logger are available with a robust 316L stainless steel housing or other materials if necessary. At a rate of one measurement per hour, the integrated lithium battery has a life of up to eight years.

The DCX-22 level measuring probes are equipped with conductivity sensors. The robust titanium electrodes have redundant seals designed to achieve reliable water and pressure tightness, while the alternating supply field is adjusted to the conductivity of the fluid medium. For measuring conductivity, the four measuring ranges of 0–200 μS/ cm, 0–2 mS/cm, 0–20 mS/cm and 0–200 mS/cm, with a measuring accuracy of ±2.5%, can be used. Since water conductivity is highly temperature-dependent, a Pt1000 sensor measures the temperature of the medium to a degree of accuracy of 0.1°C, ensuring that the measured conductivity is accurately standardised to the reference temperature of +25°C.

Bestech Australia Pty Ltd
www.bestech.com.au

ABSOLUTE MAGNETIC ENCODER

The BML absolute magnetic encoder from Balluff is designed for any application where high absolute accuracy of position and end of travel is required. Comprehensive diagnostics functions offer more efficient maintenance. With its Drive-Cliq interface the Balluff measuring system can also be integrated into Siemens controller environments.

Plug-and-play installation is designed to make incorporating the encoder into the drive system easy. The controller automatically detects the sensor and its basic settings. The sensor also offers flexibility, since leaving and re-engaging with the tape is permissible. This opens up simple and economical solutions for demanding applications in the field of automation as well as machine tool building.

Since the system works magnetically, it is also insensitive to temperature change, dirt or wear. Due to its compact form factor and read distance of 1.3 mm, the measuring system is also easy to integrate into existing applications, even in tight mounting conditions.

In practical operation, continuous plausibility checking ensures high reliability, since the system consistently checks the measurement quality. Automatic condition monitoring checks the signal quality.

The linear measuring system is suitable for both long measuring lengths up to 48 m as well as for applications requiring high precision — with an accuracy of up to ±12 μm and a resolution of 1 μm.

Balluff Pty Ltd
www.balluff.com.au

OPINION

TURNING THE DREAM OF PREDICTIVE MAINTENANCE INTO REALITY

© Stock.Adobe.com/au/ipopba

Predictive maintenance has been heralded as a solution to manufacturers' and engineers' woes thanks to its potential to give equipment users the ability to anticipate imminent malfunctions and failures that can have a disastrous impact on the whole business — so it is understandable why this technology is perceived to have huge value. According to Deloitte, predictive maintenance can reduce overall maintenance costs by between 5% and 10%.

But the key phrase here is 'perceived value'. While predictive maintenance has the capability to be truly transformative, when the time comes to implement the technology on existing equipment the process is not always straightforward, and this fact is reflected in the low number of businesses that have implemented predictive maintenance in operation.

So why is the rate of adoption so slow? Industry commentators have highlighted four factors that seem to be the key stumbling blocks that need to be conquered by equipment builders and operators to realise the dream of successful predictive maintenance solutions.

Encouraging teamwork and knowledge sharing during the design process

It can be difficult for businesses to cultivate a collaborative environment where powerful algorithms for predictive maintenance based on statistical methods can be designed — and in such a way that they integrate the domain knowledge and expertise of both data scientists and domain experts. Furthermore, how can domain experts and data scientists work together to make sure that the key elements of each predictive maintenance application are fully leveraged?

The best predictive maintenance applications include both of these components: statistics-based data analytics methods (like machine learning) and domain expertise about equipment that the R&D engineers possess. If predictive maintenance is approached with a singular data analytics mindset, users will not capture all of the useful information retained by the operations and engineering teams that build the equipment and are responsible for their ongoing upkeep.

Determining how to train algorithms without access to sufficient failure data

Training an algorithm on data from the field is a fundamental part of machine learning. Those creating the algorithm must include 'good' data from everyday production on top of a variety of failure data taken from the numerous error scenarios that can happen while the equipment is operating. However, if the goal is to never allow the equipment to break in the first place, where can the failure data be obtained?

This is turning out to be an increasingly important problem to solve for businesses utilising predictive maintenance for their industrial systems. What's more, it is irrespective of use cases and can range from air compressors to wind turbines. To overcome this issue, simulation models can be brought in to produce artificial failure data, so the algorithms have something to be trained on when there isn't enough measured failure data from the factory floor.

Taking the algorithms from the design stage to real-world operation

After the training and design of the predictive maintenance algorithm has been carried out on the desktop, the next step is deployment onto the equipment. The difficulty level of this process directly correlates with the condition of the existing IT and OT infrastructure. Whereas some algorithms are applied on a real-time hardware platform, there will be some that are in the cloud or will be merged with the current non-real-time infrastructure (for example, an edge device). At a growing rate, businesses are taking the option of implementing an efficient way of using toolchains that facilitate automatic generation of C, C++ or IEC 61131-3 code, .NET components or standalone executables.

Proving the potential ROI of predictive maintenance solutions

When any organisation kicks off a predictive maintenance project, the most important question it has to be able to answer at the outset is, how can I prove the ROI of this investment? In the absence of an answer to this question, any plan to implement a predictive maintenance plan and solution will quickly run aground. Identifying a concrete business case and developing an approach for how to monetise predictive maintenance will prove vital when trying to persuade a management team to approve the investment.

The most obvious benefit will be the reduction in equipment failure during operation. While this often justifies the investment for operators, for equipment builders building a case is more difficult. However, there are a number of ideas that have been proposed that can contribute to building a solid business. Examples are:

- Linking service fees to predictive maintenance of the equipment used by the operators.
- Taking advantage of IP protection to sell the deployed predictive maintenance algorithm itself.
- Moving to a new business model based on usage (for example, selling elevator usage hours rather than entire elevators, or cubic metres of compressed air rather than compressors).

It will be only a matter of time before the C-suite — armed with the information of these possibilities — jumps on board with realising predictive maintenance in all its glory.

Philipp H F Wallner is industry manager, Industrial Automation & Machinery at MathWorks.

FLOW/LEVEL/ TEMPERATURE SWITCH

The insertion-style FLT93F FlexSwitch for flow, level and temperature monitoring provides temperature compensation to ensure setpoint accuracy for process temperatures that vary up to 37.7°C. The SIL-2 rated FLT93F FlexSwitch is designed for fast response to perform a wide range of critical air/gas flow application tasks that meet the needs of a wide range of process and manufacturing industries. It is suitable for use in ventilation air flow, purge gas assurance, gas analysers and sampling systems, inert gas tank blanketing, hydrocarbon gas flows and high-pressure relief valve monitoring.

Featuring FCI's thermal sensing technology, the Model FLT93F combines a highly accurate, all-welded stainless steel sensing element with a user-friendly FlexSwitch control circuit. One standardised, field-configurable FlexSwitch control circuit is said to satisfy virtually any combination of flow, level and temperature application requirements.

The FLT93F FlexSwitch offers a fast response time of 0.5 s. Air/gas service accuracy is ±0.5% reading or ±0.06 nmps, whichever is higher. In liquids, accuracy is ±0.5% reading or ±0.012 mps, whichever is higher. For temperature service, accuracy is ±1°C with repeatability of ±0.6°C.

In air/gas, the setpoint range is 0.08 to 37 smps at standard conditions of 21.1°C and 1.013 bar(g). The setpoint range in water-based liquids is: 0.003 to 0.9 mps, and in hydrocarbon-based liquids it is 0.003 to 1.5 mps.

The FLT93F is available with either integral or remote electronics. The standard transmitter features dual SPDT or single DPDT relays that are field configurable.

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

3-D LIDAR SENSOR

The Pepperl+Fuchs R2300 3-D LiDAR sensor is equipped with pulse ranging technology (PRT), which provides precise measurements with high accuracy and short response times. PRT continuously measures a target's distance by using the speed of light as a constant while sending out extremely short but powerful pulses of light and calculating the duration between the time a pulse is sent and the time it is received. Mechanical separation between the emitting and receiving areas means high pollution tolerance. With 1000 points per scan line and a scan rate of 50 kHz, the 3-D LiDAR sensor is suitable for a wide range of industrial automation applications.

The R2300 series integrates four scan planes into one LiDAR sensor. Compared to single-layer devices, it produces a virtually 3-D scan, which delivers more information. By using one sensor instead of several, acquisition, wiring and integration costs are reduced.

With a high angular resolution of 0.1°, a high sampling rate and a precise light spot, the photoelectric sensor precisely detects small object structures and contours. In addition, the 100° horizontal measuring range can be reduced to any size so users only receive the measurement data relevant to their application.

Designed for longevity, the sensor can withstand impact and vibration. Due to its compact housing design, the multi-layer sensor is also suitable for applications in tight spaces such as those in AGVs.

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

2D IMAGE SCANNER

The Datalogic AV500 2D image-based reader incorporates several features that are claimed to allow the scanner to be used in a wider range of logistics, transport, distribution, retail and airport applications than were previously possible, without compromising on accuracy.

The AV500 scanner has a high-resolution 5 MP sensor, image acquisition at 32 fps, dynamic or adjustable focus, and multiple lens options. Datalogic claims that multiple reading attempts are no longer needed, because the scanner covers a large area within a single image, while the variable dynamic focus of the optical system increases the working depth-of-field of the camera and its toggle mode provides variable focus for applications without the need for distance input.

The rugged scanners come with IP65-rated metal enclosures, suitable for harsh environments with operating temperatures from 0 to 50°C. In-built active cooling maintains optimal processor performance and ensures a long lifecycle, even in extreme operating environments.

Integrated into the scanners is Datalogic's PackTrack technology, which allows parcels to be accurately scanned, even at high speeds, with distances as little as 10 cm between objects. The scanners have also been designed with a multi-language interface for simple installation and configuration, and are fully compatible with WebSentinel PLUS for real-time performance monitoring.

Connectivity with Profinet and EtherNet/IP-enabled PLCs is possible with two Ethernet TCP/IP and two serial communication interfaces. SyncNet Technology with master/slave enables a simplified way to network multiple devices in a solution with a single interface.

Datalogic Automation Pty Ltd
www.datalogic.com

THERMAL IMAGING CAMERA

The TIM40 small thermal imaging camera from Micro Epsilon is suitable for high-volume industrial applications, including those of OEMs. It has a compact and robust housing with IP67 protection, and has a measuring range from 20 to 900°C that caters for most temperature measurement requirements in industrial applications.

The unit comes with a motorised focus feature that allows the users to focus the camera on targets via remote control. This allows the unit to be integrated in an area where space is restricted.

The TIM40 thermal imaging camera also has a good optical resolution with distance-to-spot-size ratio of 390:1, making it suitable for the temperature measurement of small objects.

Featuring a fast frame rate of up to 80 fps for monitoring of fast thermal processes, the TIM40 can also be used for measurement of fast moving objects such as on conveyor belts or in research applications. The TIM40 can also be used as a fever monitoring tool in crowds to discreetly detect people with a high temperature. It can be integrated with an alarm system that alerts engineers and operators when the measured temperature rises above the defined threshold.

Integration of the camera into a user's existing system is easily done through a USB interface. The captured images are visualised in the software that is also easy to install and use.

Bestech Australia Pty Ltd
www.bestech.com.au

DATA VISUALISATION SOFTWARE FOR FLOWMETERS

Emerson has released Micro Motion ProcessViz, a standalone software solution for flowmeter process data visualisation. Having an instant visualisation of raw process data translates into direct actionable information, helping plant operators in the chemical, food and beverage, and oil and gas industries reduce the time needed to identify a problem in the flow process. Ultimately, this can potentially save a facility money by reducing the need for stoppages or shutdowns to trace the source of a problem.

The software supports the Micro Motion Coriolis transmitters with data historian output capabilities such as the 5700 and 4200 models and provides a snapshot of a moment in time in the flow process. A technician or plant manager won't need to manipulate data to see what is happening in the flow. The data is available in a usable format that allows the user to identify and analyse process issues.

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

HIGH-VOLUME MOBILE COMPRESSOR

The Mobilair 500-2 from Kaeser Compressors is said to combine the advantages of a two-stage dry-running oil-free rotary screw compressor with those of a mobile unit. It supports the production of large volumes of oil-free compressed air where portability is needed in industries from mining, construction and refineries to the production of food, beverages, chemicals and pharmaceuticals.

The M500-2 has a two-stage dry running rotary screw compressor. Due to a coating that withstands temperatures up to 300°C, the machine's sandblasted, phosphate-treated rotors are said to show no measurable signs of wear after years of operation.

A large fuel tank further ensures the M500-2 can run for two consecutive shifts without the need to refuel, and can run continuously when connected to an optional external fuel tank. The onboard Caterpillar C18 diesel engine is rated at 447.5 kW.

The M500-2 includes an integrated Sigma Control mobile controller which automatically adjusts the motor speed to the exact pressure set-point. Compressed air discharge temperature can also be selected via the controller.

Weighing almost 12 tonnes, this portable compressor also comes as standard with a spark arrestor and motor shut-off valve for installation in refineries and is mounted on a supporting chassis with parking brake so that it can be quickly and safely positioned anywhere. It also features crane and lashing eyes, as well as forklift pockets.

The M500-2 delivers compressed air from 4 to 10.3 bar. Maximum free air delivery varies from 38 m^3/min (10.3 bar) to 45.8 m^3/min (6.9 bar).

Kaeser Compressors Australia
au.kaeser.com

SAFETY AT WORK

HOW CAN MACHINE TOOLS AND SYSTEMS OPERATE SAFELY AND EFFICIENTLY?

For a while now, sensors have been not only a component of process control: today one of their primary tasks is to link processes together.

With its extensive range of Safety@work products, Leuze electronic optimises collaboration between man and machine: sensor and control systems, like those of the RSL 400 safety laser scanner, can be integrated intelligently into the processes performed by machines and safeguard those machines in a reliable and tamper-proof manner. At the same time, the processes are structured efficiently and cost-effectively.

Machining work pieces

In machining centres, parts of various materials are machined, turned, and drilled. The prerequisite for processing work pieces in complex machining centres with a high degree of precision is having the right tool available for each work step. In addition to checking whether the tool is present and identifying it, the drill or milling cutter must also be monitored for tool breakage. Inductive switches or camera-based code readers clearly identify whether the correct tool is mounted for the respective processing step. Focused laser photoelectric sensors can — thanks to their very small light spot — reliably check whether even the smallest drills or milling cutters are intact.

Increased level of automation

Industrial robots, which can perform a large number of swivel and gripping movements in a very short period of time, are often used for automated loading and unloading of machine tools. Their movement zones must be reliably protected against access over a large area. Before a robot picks up a part, the part must be uniquely identified to ensure that the correct processing step is carried out. This is done using the DCR 200i camera-based code reader. The DCR 200i is a reader used to detect and identify Data Matrix codes. The fast imager, integrated high-performance LED illumination, as well as high resolution in combination with a very high depth of field guarantee reliable decoding, even with fast processes and high object speeds.

Safety-related monitoring of machines and systems

Safety laser scanners such as the RSL 400 from Leuze electronic are used for the safety-related monitoring of areas in and around machines and systems. A maximum operating range, robust operation and simple handling are crucial here. The simultaneous monitoring of four protective fields means the working area can be split up and the speed safely reduced.

In future, an important aspect in addition to the automated loading and unloading of machine tools will above all be the linking together of multiple machine tools in combination with automated production processes. This includes, for example, storage systems that optimise material flow, and also a wide variety of transport equipment such as linear gantries, pallet handling systems and conveyor systems. For the safeguarding of large access points, safety laser scanners with vertical alignment of the protective field are used, e.g. to detect vehicles and persons.

The RSL 400 safety laser scanner provides a solution for such applications. Its large operating range of 8.25 m allows large areas to be monitored. With two parallel protective fields and two integrated safety-related switching outputs, one RSL 400 safety laser scanner can monitor two stations independently of one another.

A further option is safeguarding using multiple light beam safety devices. These devices provide a greater operating range and therefore an efficient solution for safeguarding access points over long distances of up to 70 m — even ‘around the corner’ solutions with multiple mirror columns are possible. Products such as the MLD 500 safety light curtain have an integrated laser alignment aid for time-saving and cost-effective alignment. Simple configuration by means of wiring and integrated indicator lights for status display are possible, even over long distances.

In-house logistics with automated guided vehicles (AGVs)

An AGV, which moves autonomously and flexibly in space, transports blanks into the working area of the robot or machine tool. On completion of the production process, the machined work pieces are collected again. The transportation path of the AGVs must be safeguarded with safety sensors that monitor the presence of people and objects. An important consideration here is the flexible adaptation of the protective fields to the movement situation and the different loads. In the case of the triangulation principle, an AGV must be equipped with two different scanners, but with the contour navigation principle it is possible for just one scanner to provide both safeguarding and navigation. The measurement values also have an extremely high angular resolution and accuracy, which is important for precisely determining the position of the AGV. The RSL 400 safety laser scanner enables such a combined solution.

The safety laser scanner is available in various models. The extensive range of scanners from Leuze electronic includes a total of nine functional variants — three of which offer data output for AGV navigation. All variants are available for the four operating ranges of 3.0, 4.5, 6.25, and 8.25 m. Models with PROFIsafe/PROFINET interfaces are also available.

Leuze

Leuze electronic Pty Ltd
www.leuze.com.au

NEW PRODUCTS

HIGH-TORQUE BRUSHLESS DC MOTORS

The recently released 90 mm diameter brushless DC ventilated motors from maxon give power level increases from 160 to 600 W within the same diameter. Two length options of 27.4 and 39.9 mm are selectable with two air-cooling options. Four winding options are available for DC voltages varying from 12 to 60 VDC. Continuous torque capability is up to 1610 mNm from the motor alone; when combined with planetary, worm and helical gearhead options, repeated peak torque levels of 650 Nm have been achieved.

High ratios and 25600qc integrated internal encoders make them useful devices for rotary joint applications such as robotics and industrial machinery actuators. The company can also manufacture custom versions with specific cable looms and rear shafts for mounting loads on both sides of the motor. The combination of the flat motors with high stiffness, low profile, zero backlash and trochoidal-style gearheads also makes the complete drive suitable for wheel drive applications such as autonomous ground vehicles and warehouse logistic machinery.

maxon motor Australia Pty Ltd
www.maxonmotor.com.au

OXYGEN ANALYSER

Michell Instruments has launched a lightweight oxygen analyser designed to provide accurate and cost-effective control of oxygen from 500 ppm O_2 to oxygen purity in safe area applications.

The XTP501 Oxygen Analyser uses Michell's thermo-paramagnetic technology for highly accurate and stable measurements. These sensors are non-depleting and will last for the life of the instrument under normal operation, which keeps the cost of ownership low since only minimal maintenance is required and there are no consumable parts to replace.

The analyser offers users a choice of ranges to ensure the best accuracy for specific applications. There are six available ranges to choose from: 0–1/21/25% O_2 and 20/80/90–100% O_2, which are suitable for a wide range of application needs from monitoring trace oxygen in inert gases to ensuring the purity of oxygen generated for use as an industrial gas.

The XTP501 is a highly stable instrument at ±0.25% of span per month and accurate to ±0.02% O_2. Because they have no moving parts or liquid components, thermo-paramagnetic oxygen sensors are robust and not affected by vibration or sudden shocks.

With a lightweight IP55-rated casing, the analyser is compact and easily installed. Suitable for indoor installation, the IP55 case makes it robust enough for most industrial safe-area conditions such as food and beverage production, non-hazardous installations and small-scale industrial gas production. It has an intuitive touch screen interface that is easy to use, interrogate and set up.

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

MODULAR DRIVE CONCEPT

NORD Drivesystems creates individually tailored drive solutions for intralogistics applications based on the LogiDrive concept, said to be an energy-efficient, service-friendly and standardised modular system. LogiDrive drive units consist of an IE4 synchronous motor with rated powers of up to 5.5 kW, a two-stage helical bevel gear unit and a NORDAC LINK frequency inverter that is installed close to the motor. The entire system has a modular design, so that all components of the drive technology can be individually serviced. With the latest IE5+ synchronous motor the LogiDrive concept's energy efficiency and reduction of variants may be further optimised.

Planning a system with drives that are designed for the most energy-efficient operating points leads to optimal investment costs and motors operating comparatively energy-efficiently, independent of their efficiency class. For this purpose, many different drive variants must be managed and serviced during the system's entire lifecycle. A reduction of variants aims to provide an economically viable coverage of the required speeds and torques within a system, using a minimum of different drive variants. If required, NORD provides this optimisation service in the context of customers' projects. Variants may be reduced by using only one geared motor and frequency inverter size for a specific speed and load range. Controlled via the frequency inverter, this drive unit may then cover all required operating points for lower performance requirements or other speed ranges. This is possible with LogiDrive concept synchronous motors as they operate independently of load and speed.

NORD Drivesystems (Aust) Pty Ltd
www.nord.com

CONTINUOUS LEVEL MEASUREMENT

IS NON-CONTACT RADAR ALWAYS THE ANSWER?

Some instrumentation vendors may offer non-contact radar as the instrument of choice for almost any continuous level measurement scenario, but be careful… For some years now, non-contact radar level instruments have been a popular technology for continuous liquid level measurement, and this is for good reason. There are many benefits to non-contact radar as level sensing technology, not the least of which are:

- Accurate readings that are independent of product density.
- No contact with the substance being measured, allowing the level measurement of corrosive and toxic liquids.
- No moving parts and any risk of fouling is easily mitigated.
- Ease of installation and accessibility, typically located at the top of the vessel.
- Minimal or no reconfiguration required when changing the contents of the tank.

It is not surprising that some instrumentation vendors may offer non-contact radar as the instrument of choice for almost any continuous level measurement scenario.

But be careful: there are also good reasons not to use non-contact radar instruments, and we shouldn't forget many of the other well-proven technologies that are available.

We love non-contact radar but...

Not all situations are well suited to the use of radar instruments: the instrument may perform poorly in some situations or may cost more than alternatives.

Success factors

The main factors affecting the accuracy of non-contact radar are the relative permittivity of the medium (also known as the dielectric constant) through which the microwave radio signal must propagate (and off which it must reflect), multi-path interference from metal obstructions in the tank and the signal loss due to signal dispersion or other factors such as foam.

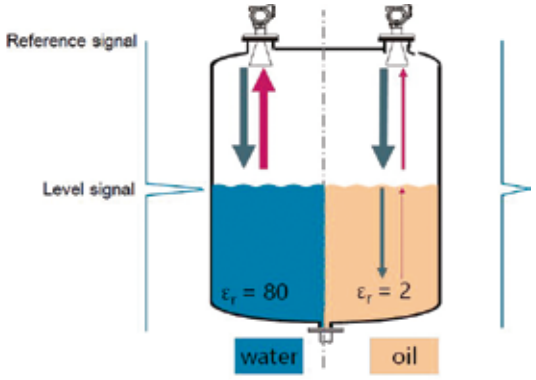

Figure 1: The strength of the reflected signal depends on the relative permittivity of the liquid.

Reflected signal strength

The reliability and accuracy of non-contact radar measurement depends on there being a sufficiently strong and interference-free signal reflected back from the liquid surface. The main factors that impact this are:

- The dielectric constant of the medium to be measured.
- The distance of propagation above the interface, and the beam width of the instrument.
- Foam and other obstructions.
- Liquid agitation or vessel-related issues.

When the liquid has a high dielectric constant (such as water, $\varepsilon_r \approx 80$), then the reflected signal at the surface is strong. The power reflection factor at the interface is given by:

$$R = \frac{(\sqrt{\varepsilon_{r2}} - \sqrt{\varepsilon_{r1}})^2}{(\sqrt{\varepsilon_{r2}} + \sqrt{\varepsilon_{r1}})^2}$$

In the case of water with air above (ε_{r1} = 1), the reflection ratio is 68.3%, whereas in the case of a low-permittivity liquid such as kerosene (ε_{r2} = 1.8 at 21°C) the reflection ratio is 2.1%.

It must be remembered that in a non-contact radio situation the radio signal disperses as it approaches the medium and the (weaker) reflected signal is also dispersed as it propagates back. Signal dispersal can have greater effect in large vessels; especially at low liquid fill levels. Foam, agitation, dust or fog on the liquid surface can also reduce the strength of the returned signal.

The effects of weak signal return can be mitigated by the choice of antenna, or using a higher frequency instrument, which narrows the beam, albeit at a higher cost. However, because of the issue of signal dispersal, non-contact radar is limited to simple level measurement and is not recommended to provide reliable multiple interface detection.

The gas phase effect

For a time-of-flight measurement to be accurate, the propagation velocity of the transmitted and received signals must be certain. The velocity of radio propagation in a medium is given by:

$$v = \frac{c}{\sqrt{\varepsilon_r}}$$

A complication that can arise is when the gas phase above the medium to be measured has a dielectric constant greater than 1, so that the propagation velocity of the microwave signal can be affected by changes in pressure or temperature. Such situations could arise in cases where the liquid to be measured is a volatile substance emitting vapour.

Gas phase	Temp	Pressure							
	℃	1 bar 14.5 psi	2 bar 29 psi	5 bar 72.5 psi	10 bar 145 psi	20 bar 290 psi	50 bar 725 psi	100 bar 1450 psi	200 bar 2900 psi
Steam (water vapor)	100	1.005806							
	120	1.005227	1.010601						
	152	1.004476	1.009048	1.023424					
	180	1.003950	1.007964	1.020432	1.042934				
	212	1.003458	1.006960	1.017743	1.036765	1.079856			
	264	1.002840	1.005705	1.014456	1.029597	1.062307	1.192220		
	311	1.002418	1.004851	1.012252	1.024933	1.051729	1.147384	1.424747	
	366	1.002036	1.004082	1.010283	1.020834	1.042799	1.116952	1.282623	3.086361

Figure 2: An example of the effect on propagation velocity of changing temperature and pressure when the gas phase is steam.

In such cases, not only must the instrument be calibrated accordingly for a lower propagation velocity, but there may also be a need for temperature and pressure compensation applied to the measurement — creating the necessity for additional instrumentation, and additional expense.

Vessel challenges

In some cases, the vessel holding the liquid to be measured can present challenges for a non-contact radar instrument. For example, if the vessel contains large metallic obstructions such as stirrers and agitators, it may not be possible to avoid interference, even with a narrow-beam high frequency radar.

Also, if the liquid is subject to frequent disturbance, ripples, bubbles and foam can have an impact on accuracy of the instrument. If a stilling well is to be used, it would need to be carefully designed to avoid internal radar reflection, and a narrow-beam radar would be a must.

There are two ways to achieve a narrower beam width: changing to a higher gain antenna or choosing an instrument with a higher frequency. Typical operating frequencies for non-contact radar are 1, 6, 26 and 80.

Alternative technologies

There are a number of continuous level measurement technologies that could be used in place of non-contact radar, many at a lower entry cost.

Guided-wave radar

A guide-wave radar (GWR) transmitter works by the same time-of-flight principle as a non-contact radar instrument, but has a rod or cable that extends into the tank to 'guide' the radar signal. The effect of the waveguide is to almost eliminate the effect of signal dispersal, resulting in a stronger return signal to the transmitter. The fact that the waveguide can reach to the bottom of a vessel (typically up to 45 m), coupled with the stronger return signal, makes GWR instruments suitable for multiple interface detection, which non-contact radar is not recommended for.

For multiple interface detection, ideally the upper liquid should have an ε_r of less than 10, making the technology suitable for most applications in the chemical and oil and gas industries.

Disadvantages

In multiple interface applications, the interface may not be well defined due to some mixing of the layers, resulting in a 'rag layer' that will cause inaccuracy if too thick. GWR instruments are also not suitable for materials that may cause fouling through deposit build-up on the rod or cable.

Ultrasonic

Similar to a non-contact radar instrument, ultrasonic level sensors measure the distance between the transducer and the surface using the time-of-flight of an ultrasound pulse to travel from a transducer to the fluid surface and back. Transit times are typically 6 ms/m, but depend on the mixture of gases in the headspace and their temperature.

The main advantages of ultrasonic sensors are their comparative ease of installation and compact size, and the fact that they are not dependent on the liquid being measured, as they are responding only to the difference in density between the liquid and the head space atmosphere. They are best suited to level measurement in water and wastewater applications, as well as some chemical applications.

Ultrasonic devices by design have a vibrating membrane that has a self-cleaning effect to minimise any build-up due to condensation.

Disadvantages

While the sensor temperature is compensated for (assuming that the sensor is at the same temperature as the air in the headspace), this technology is usually limited to atmospheric pressure measurements in air or nitrogen.

Capacitance

Like the GWR transmitter, a capacitance transmitter has a probe that extends to the tank bottom and measures the capacitance of material that is in contact with the sensor. It may either be a single rod/cable measuring the capacitance between the probe and the (conductive) vessel wall or it may be a probe within a tube, measuring the capacitance between the two elements, which have a known geometry. As the liquid rises and falls up the probe, the capacitance varies according to the fill level.

A second interface can be detected, but only if the lower liquid is conductive. One advantage of using capacitance in interface applications is that it is not affected by emulsions or rag layers.

Disadvantages

Capacitance probes are not suitable for materials with a low dielectric constant, and while a capacitance probe is not as susceptible to errors due to product build-up, it is highly sensitive to changes in the dielectric constant of the material. The process material conditions therefore need to be assessed to determine whether there can be changes in temperature, moisture content or density that may change the dielectric constant of the material.

Differential pressure

With differential pressure measurement (DP) the measurement is the difference between total pressure at the bottom of the tank (hydrostatic head pressure of the fluid plus static pressure in the vessel) and the static or head pressure in the vessel. The hydrostatic pressure difference equals the process fluid density multiplied by the height of fluid in the vessel. A vent at the top keeps headspace pressure equal to the atmospheric pressure.

Disadvantages

If the vessel needs to be closed, the lack of a vent in the headspace means that a second pressure transmitter must be utilised at the top of the tank and the level calculated from the differential between the two transmitter outputs.

Accurate measurements are also dependent on constantly knowing the density of the process fluid, which can often vary with temperature, and so additional temperature compensation must be used. The method also depends on two penetrations of the vessel, and the lower penetration can be a source of leaks.

Electromechanical systems

For simple level applications, float sensors are a well-tried and proven technology. Floats work on the simple principle of placing a buoyant object with a specific gravity intermediate between those of the process fluid and the headspace vapour into the tank, then attaching a mechanical device to read out its position.

Similar to a float, a displacer is designed to float on a liquid, but can operate submerged, allowing interface level detection, by being calibrated to the specific gravity of the lower fluid.

Disadvantages

With floats and displacers, getting the actual reading can sometimes be problematic. Many systems utilise mechanical components such as cables, tapes, pulleys and gears to communicate level; however, magnet-equipped floats can help alleviate some of these difficulties. Additional problems can be caused by agitation of the fluid — making a stilling well necessary — or if the fluid tends to coat the float, impacting its ability to float on the surface.

Radiometric systems

Radiometric level measurement systems work by placing a radioactive source on one side of a vessel and measuring the radiation reaching the other side of the vessel. A measurement of the level of the substance within the vessel is obtained since the substance will attenuate the signal reaching the radiation detector on the other side.

Radiometric systems utilise gamma rays from a source such as Cesium-137, and since the gamma radiation can pass through the walls of the vessel, require no penetration of the vessel or contact with the liquid inside. This makes them suitable for measuring extremely hot, toxic or corrosive substances that would damage other types of instruments.

Disadvantages

The main disadvantage of radiometric systems is their high cost, not only in procurement, but also in maintenance and disposal. Being dependent on a radiation source, they are 'always on' and appropriate safety measures must be taken in the handling of the radiation source. They therefore tend to be used where no other technology is suitable for dealing with the process conditions.

Conclusion

While not exhaustive, the above describes a number of liquid level measurement technologies — well established in the marketplace — that can offer an alternative to non-contact radar instruments.

While in many cases non-contact radar is an excellent technology for liquid level measurement, one should be careful about suggestions that the technology may be suitable in all cases: there are situations in which other alternatives can be more effective, or will achieve the same result. Finding the most effective technology for the application may require expert help from a trusted supplier with experience in all available technologies.

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NEW PRODUCTS

GAS ULTRASONIC FLOW METER TRANSDUCER

Emerson has released the Daniel T-200, a titanium-housed transducer, for its gas ultrasonic flow meter product line, utilising metal 3D printing to enhance the acoustic performance of ultrasonic flow meters in custody transfer applications.

Ultrasonic signal quality and strength are critical to measurement accuracy, which is paramount in custody transfer applications. To boost signal strength through the titanium housing, the T-200 uses a metal 3D-printed mini horn array, which consists of an intricate geometrical structure of titanium horns and a titanium diaphragm that acts as a harmonic oscillator and matching layer. This maximises the sound energy coupled into the gas, which improves the signal-to-noise ratio and accuracy of the measurement.

The meter's all-metal housing provides a barrier from corrosive hydrocarbon fluids and wet gas, thereby extending the life of transducer components and ensuring stable performance. This design allows the meter to be hydrotested with transducers in place, steam cleaned while in the operating line and blown down with no limits on the rate at which the meter can be depressurised.

The T-200 can also be safely extracted while the meter is under pressure without special high-pressure extraction tools, which reduces the possibility of greenhouse gas emissions during extraction. The capsule which contains the piezoelectric crystal is retractable as a single piece for simplicity and ease of use.

The T-200 is rated for a wide range of operating conditions, including pressures from 15 psig/103 kPa to 3750 psig/25,855 kPa and temperatures up to 125°C.

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

ETHERCAT SERVO DRIVE

Trio Motion has released an EtherCAT servo drive that can be integrated with an existing motion control system. The DX4 drive is designed to be compact in size but also to have power ranges capable of driving many different motor configurations.

The drive has standard inputs and outputs with an additional encoder input for secondary feedback. It can be used with motors with high feedback or Trio's servomotors, which have 20-bit incremental and 23-bit absolute feedback options available. This makes it suitable for a wide range of applications that require high precision.

Users can integrate it with their own EtherCAT master control or integrate it with a complete Trio Motion system.

Motion Technologies Pty Ltd
www.motiontech.com.au

HANDHELD VIDEOSCOPE

The Olympus IPLEX GL 3.5 m x 6 mm handheld videoscope is lightweight and portable, making it suitable for all challenging working environments. It has a remote visual inspection tool and high image quality that helps get inspections tasks done easier and with precision. It is available to rent from Tech Rentals.

The device also lets users screen-share wirelessly to send live inspection images and video to smartphone and tablets.

Its PulsarPic image processer constantly optimises images by reducing halation, balancing exposure and improving gain quality. The LED light on the videoscope is also twice as bright as its predecessor, helping to locate problems and defects in dark areas with greater accuracy. Users can also record moving objects clearly and stutter-free with the device's high frame rate (50 fps).

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I HAVE MY HEAD IN THE CLOUDS

The title has two meanings for me. Firstly, I literally have my head in the clouds as I have been exploring cloud computing. Secondly, I feel like I am living in a fantasy world where I have access to unlimited computing resources and domain expertise from any part of the world.

Just like clouds in the sky, cloud computing is ubiquitous and versatile. There are different ways to use cloud services: Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS).

In a recent application of cloud computing, I used IaaS to migrate on-premise SCADA servers to Microsoft Azure. These servers collect data from offshore platforms using satellite connections provided by a third-party vendor. The primary reason for this migration was scalability; as demand from clients increased at an unprecedented rate, the existing infrastructure reached its capacity prematurely. In a traditional on-premises approach, capacity increase would require capital expenditure (CapEx) approvals. This highlights the second compelling reason: shifting investment from large CapEx to smaller operational expenditure (OpEx). The justification of CapEx is more challenging than OpEx because it requires a forecast of future demand over the next two to three years. This forecast period is usually related to the typical lifespan of infrastructure — which becomes irrelevant in cloud computing. Incidentally, with cloud computing users are released from the tedious tasks of maintaining on-premise hardware.

During the proof of concept for this migration, I was on cloud nine because I could execute all of the tasks from the comfort of my office. These tasks included testing connectivity from a remote terminal unit (RTU) to a SCADA server in Azure, collaborating with the satellite connection vendor located 3000 km away and interacting with end users to optimise the user experience at their own workstation.

The elastic and centralised nature of cloud computing could come at the expense of data reliability, latency, network bandwidth and data security if we are not careful. Therefore, a robust security architecture is vital. Security should be built into data generation at the devices, data ingestion at the edge, data transport between edge and cloud, and data protection in the cloud.

However, even the most robust and well-designed security architectures can be undone by poor practices. To reinforce the vulnerable link between technology and real people, enterprises need to support users with proper training and a strong cultural awareness of data security.

With security architecture and competent users in place, IT can apply existing infrastructure to detect anomalies and remove potential threats. Besides being the guardian of the enterprise's cyber attack surfaces, IT also ensures proper network segregation within the enterprise and harmonisation between different business units, with OT being one of them. Consequently, OT should work with IT to ensure success in their IIoT cloud deployment.

As I see it, the IIoT cloud unlocks plenty of possibilities for the OT world. To rise above the dark clouds of improper deployment, enterprises should arm users with best practices in data security and advocate IT/OT collaboration.

Mei Wan is a chemical engineer who has spent 15 years delivering process automation projects for a range of industries. As the Solutions Architect for Emerson Automation Solutions in ANZ, Mei helps clients tackle business challenges with IIoT and other digital technologies.

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