PROCESS TECHNOLOGY

AUTOMATION + CONTROL + INSTRUMENTATION

November 2019 vol.33 no.6

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119

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NOVEMBER 2019

CONTENTS

4 The road from automation to autonomous systems

8 Hot Products online

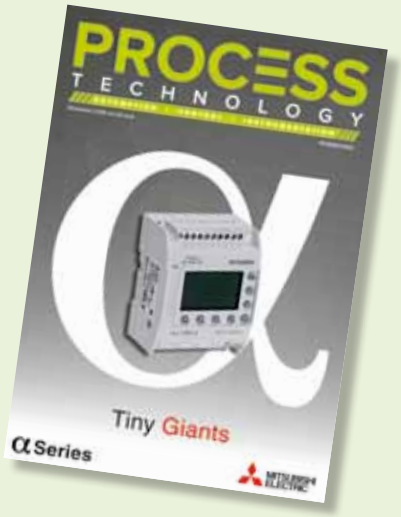
16 Condition monitoring using the drive as a sensor

24 Is 5G ready for manufacturing?

28 Choices in gas detection

42 Fearlessness — the true driver of digital transformation

ON THE COVER



Mitsubishi Electric's Alpha controller launched over 20 years ago. Ahead of its time when launched, the Alpha controller is still relevant for many new and innovative automation applications.

Applications for Alpha include everything from replacing timers and counters in traditional switchboards, monitoring and control of air conditioning, lighting and pump control to telecommunication systems using GSM capability.

The units are designed to operate in a temperature range from -25°C to 55°C, making the Alpha controllers ideal for applications inside and outdoors.

The Alpha controller can process up to 200 function blocks in a program which include timers, counters, analog value processing, calendar and time functions.

In addition to convenient and simple software, the controller can be programmed from the buttons on the front panel, making maintenance and programing possible without a PC.

The Alpha controller is just the beginning of Mitsubishi Electric's suite of factory automation products. Mitsubishi Electric's iQ platform brings together a full automation suite, including the GOT2000 range of HMIs, the powerful modular automation controller iQ-R series, the high performance FR-A800 range of inverters, as well as the high function MR-J4 servo systems and the FR range of industrial robots — all developed to provide a next-generation automation environment focused on adding value while reducing total cost of ownership.

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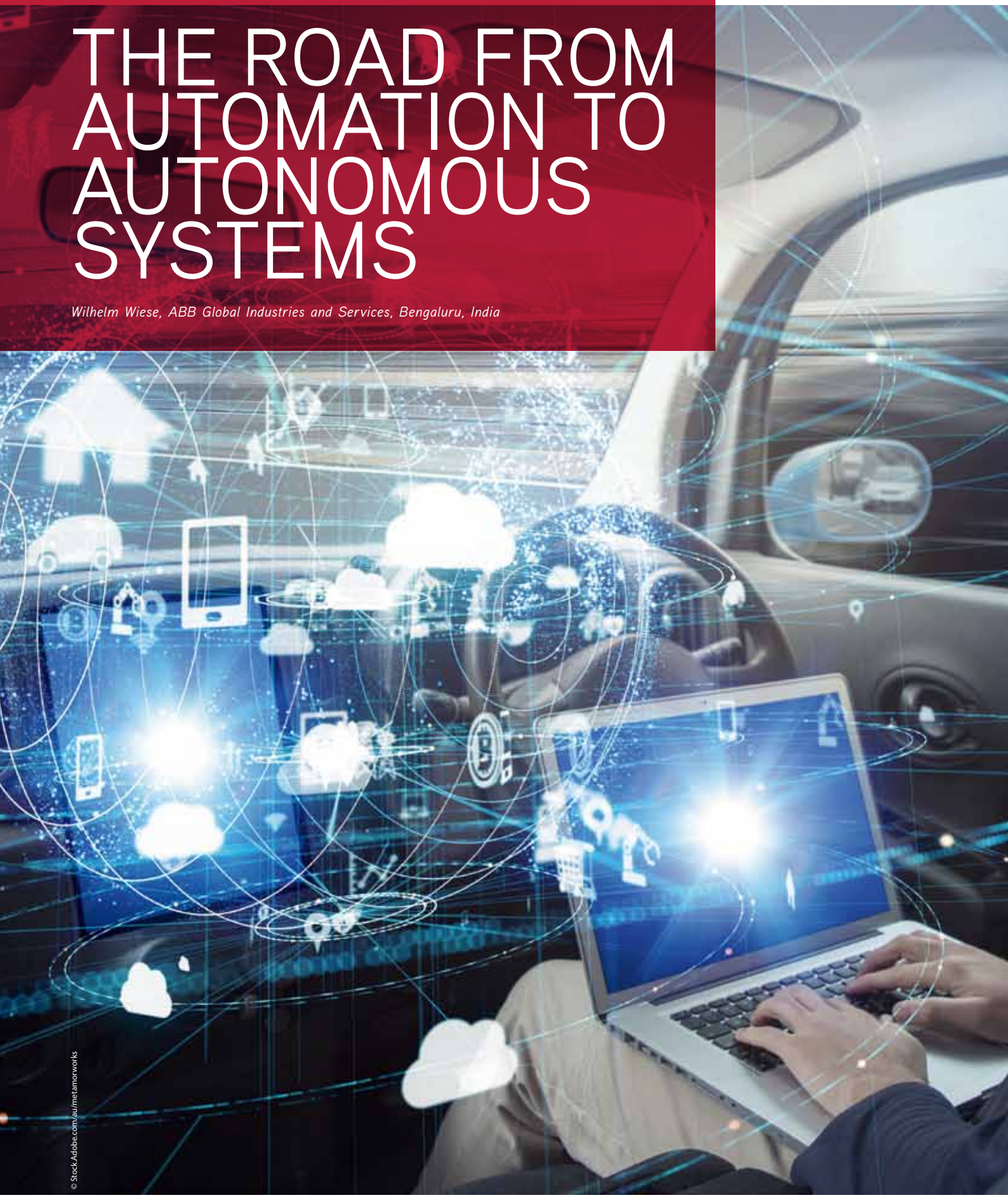
THE ROAD FROM AUTOMATION TO AUTONOMOUS SYSTEMS

Wilhelm Wiese, ABB Global Industries and Services, Bengaluru, India



Data is often referred to as the oil of the digital economy; but in the context of the Fourth Industrial Revolution, self-learning algorithms for autonomous engineering, operation and control are likely to be the key to success.

Everybody is talking about autonomous cars. Indeed, the progress this technology has made during the last few years is so impressive that it's way ahead of what is happening in the field of industrial automation. So, to better understand what is going on, it is instructive to look at how the automotive industry defines the five levels of autonomous driving in the context of today's industrial automation systems (see Figure 1).

Comparing autonomous driving levels with industrial automation

Level 0

This is where we are today: where a human controls it all. In the context of industrial automation, level zero is how operators run their plants during the start-up phase, and when they configure and optimise processes.

Level 1

According to the US National Highway Traffic Safety Administration (NHTSA), this level is characterised by "an advanced driver assistance system (ADAS) … that can sometimes assist the human driver with either steering or braking/accelerating, but not both simultaneously".[1]

In the context of industrial automation, this is replicated by control loops that keep particular process variables at set points based on feedback from sensors.

Level 2

The NHTSA describes this level as "an advanced driver assistance system (ADAS) … that actually controls both steering and braking/accelerating simultaneously under some circumstances. The human driver must continue to pay full attention at all times and perform the rest of the driving task." In the context of industrial automation, this is how most operators run their plants. They are in the control room to observe production and step in only if an alarm indicates that specific process variables have drifted in an undesired or unexpected direction.

Level 3

According to NHTSA, this level is characterised by "an automated driving system (ADS)… that can itself perform all aspects of the driving task under some circumstances. In those circumstances, the human driver must be ready to take back control at any time when the ADS requests the human driver to do so. In all other circumstances, the human driver performs the driving task." In the context of industrial automation, this is roughly equivalent to a plant with continuous production and only a handful of service personnel onsite to keep the operation running.

Level 4

This level refers to an "automated driving system (ADS) … that can itself perform all driving tasks and monitor the driving environment — essentially, do all the driving — in certain circumstances. The human need not pay attention in those circumstances." Today's automation technology is still far from this level in most industries.

Level 5

Here, an "automated driving system (ADS) … can do all the driving in all circumstances. The human occupants are just passengers and need never be involved in driving." We expect it to take quite some time before even the automotive industry reaches this level.

Three views of industrial autonomous systems

Having examined the autonomy levels of self-driving cars, we now need to consider at least three views of industrial autonomous systems (Figure 2).

Autonomous engineering

Most discussions of autonomous systems centre on autonomous operation. However, a preÂcondition for autonomous operation is autonomous engineering. Using the vision of the Fourth Industrial Revolution as a guide, the development of industrial automation can be interpreted as parallel to the five levels of autonomous driving. Considering the production and optimisation of smartphones, for instance, these devices are characterised by hundreds of configuration parameters designed to allow users to customise their communication experiences. However, although more than 90% of all

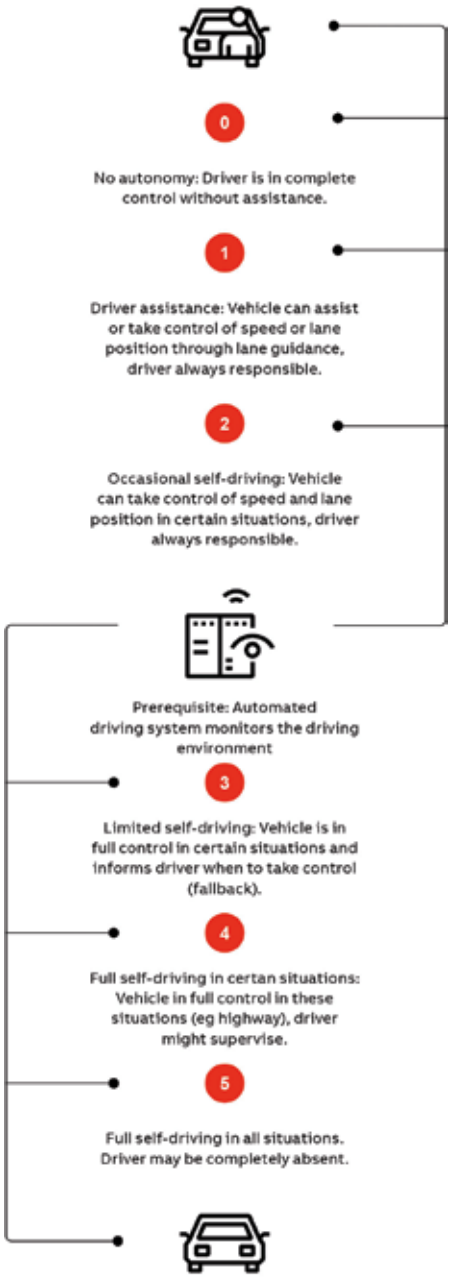


Figure 1: Levels of autonomous systems as exemplified by self-driving vehicles.

	Level 1	Level 2	Level 3	Level 4	Level 5
Control		×			
Operation		×	×		
Engineering	×				

Figure 2: Levels to which autonomy has been achieved in industry.

settings are kept at default values, some users take the time to tweak their devices and applications for optimal performance. And in those cases where the tweaks can be shared with the supplier, the information can be used to improve the product, reduce troubleshooting costs and optimise default parameters.

A further step could be a scenario in which all smartphones can upload their improved configurations into a vast data lake that would be available to all. By the same token, today's industrial automation technology already connects millions of devices. This, along with the knowledge of how devices associate with each other, in which industrial applications and under which environmental conditions, is the foundation for autonomous engineering.

Using the capabilities of big data analytics, one can derive device and application settings that are much better than the default settings. The data model continuously refines the settings. For guidance similar to that provided by an advanced driver assistance system, engineers can then either choose default parameters given by the product owner or the settings most of the engineers around the globe have chosen in a similar set-up for a similar application in a comparable environment. This combination of human and machine resources would move autonomous engineering from level one to two. Once this becomes mature, it would allow moving to level three, where a plant could autonomously change its configuration, for instance based on environmental changes between summer and winter. This is the reason why autonomous engineering is to some extent a precondition for autonomous operation.

Autonomous operation

Today's plant operation technology has reached a level of autonomy somewhere between levels 2 and 3. But it will take much more than just autonomous engineering to reach full autonomy. To achieve this, systems will have to combine device and application settings, as well as process values. A good starting point is an analysis of data from decades' worth of alarms and events that tell operators how production systems have performed under a vast range of conditions.

It must, however, be kept in mind that human error is still the main cause for production failures and plant shutdown.[2] In view of this, the availability of plant-wide data is obviously at the core of autonomous operation and is a prerequisite for unlocking the potential of today's technology and data analytics. Machine learning, with its unlimited storage and computational power, allows us for the first time to take advantage of this. But to become fully autonomous, such a system must be able to automatically change a configuration if it detects a novel fault situation — in other words, it must be able to go beyond what it has learned from a vast data set of previous situations and be capable of triggering and configuring new alarms by itself and reacting to them. This new setting is far more complex than anything engineers have configured to date. Here, data is the beginning of autonomous operation, while self-learning algorithms lead to the next level of autonomy.

Autonomous control

This leads us to the concept of autonomous control, which is probably the most controversial part of autonomous systems. The most persuasive argument used against machine learning replacing today's control-loop-based automation (Figure 3) is that the response of a control loop is deterministic while machine learning is probabilistic. One can hardly doubt that a single control loop is deterministic, but one should question whether a control system based on hundreds or even thousands of control loops is also deterministic.

In view of this, the probabilistic responses generated by machine learning-based AI could profoundly alter tomorrow's industrial control systems. While it is true that control systems based on Third Industrial Revolution technologies have reached very high reliability and performance standards, the capabilities of those that will be based on Fourth Industrial Revolution technologies will accelerate at a speed the industry has never seen before. A probabilistic response of 80% today might become 90% soon, which would be close to those of a deterministic system if we consider a whole process area or plant.

In coming years artificial intelligence will change today's control paradigm from signal marshalling to process data analytics, from feedback loops to prediction, and from process calibration to self-optimisation (Figure 4). AI-based

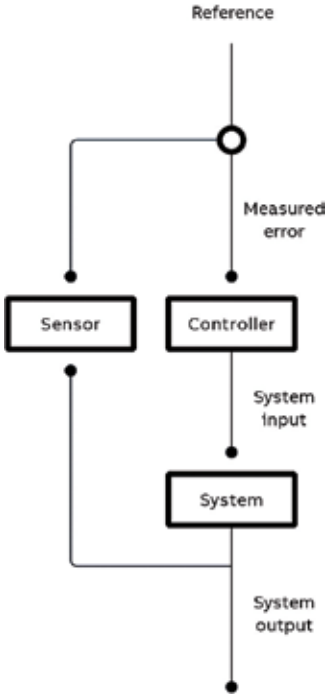


Figure 3: Control loop-based automation.

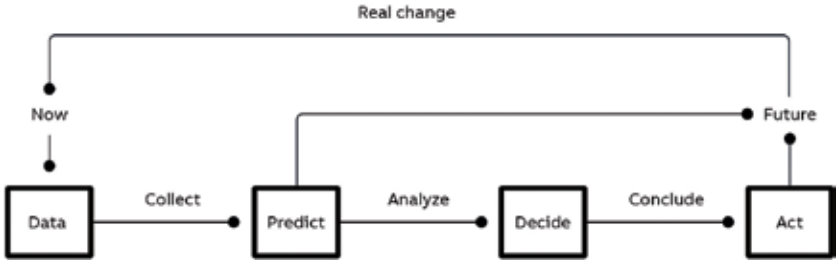


Figure 4: Operational risk management blueprint for AI.

systems will also soon be far better than traditional control loop systems because machine learning can correlate hundreds and thousands of parameters instead of just comparing a variable with a set point. In order to take advantage of this, the next level of autonomous control will have to holistically address entire industrial automation systems. This will call for feeding all engineering data, device parameters and their operations, as well as process and environmental data, into a machine learning-based system and training it based on physics, feedback from the quality assurance system, and the experience of operators and plant engineers. Once these steps have been taken, control loops will no longer be needed to determine process input parameters for devices. Device-wise this will initially cause a disruptive transition because industrial automation devices in the installed base are not capable of hosting machine-learning engines; but it can be expected that the next generation of industrial devices will be much more powerful.

Technology-wise, AI-based control systems will probably completely replace today's distributed control systems — firstly, because they will deliver better results faster, and secondly, the architecture of today's control systems is outdated. Distributed control systems have their roots in the Third Industrial Revolution where computing power and storage capacity were scarce and real-time communication required the proximity of controls to equipment. All these constraints are no longer valid, particularly with the upcoming advent of 5G wireless communication.

Market-wise, the good news is that this transition will be relatively slow because of the enormous size of the installed base, thus giving users time to implement and familiarise themselves with new systems.

Roadwork ahead!

Successful players will need to be agile and fast in terms of service development. They will accomplish this by limiting the role of proprietary hardware to a minimum and shifting their focus to cloud-based software-as-a-service (SaaS) solutions. Finally, they will need to transition to control systems that are based on architectures and designs built from the ground up with autonomy in mind. The architecture and design of tomorrow's autonomous industrial systems will have to support autonomous engineering, operation and control.

To accomplish this, future autonomous control systems will have to start bottom-up because the control layer and the underlying field layer provide the process- and device-specific data for data analytics and new AI-based solutions. Starting from the control layer also explains why it cannot be an extension of today's hardware because today's industrial controllers lack the power to compute, or the memory to run, additional analytics or AI processes. Nevertheless, the first step will obviously be to maintain today's software while migrating it to a more powerful platform — such as a virtual controller running in a cloud environment.

Starting with the architecture from a virtual controller solves many requirements on the way to fast and agile data analytics, AI-based solutions and autonomous systems. Firstly, all data will be easily accessible for data analytics and AI micro-service applications within the same cloud environment. Secondly, unlimited computational power and memory can enhance the control software with new features and interfaces. And finally, new features can be quickly deployed within the cloud and do not require any hardware changes or extensions, thus maximising speed and agility.

Conclusion

Autonomous control will take time to realise and will call for many intermediate steps. While it is certainly a challenge, it is attainable with a stepwise approach. The key to agility and speed is to change the mindset from a transactional product business to software-as-a-service and minimise the development of proprietary hardware. The key to success is two-fold: on the technology side development must start from a base architecture built on a vision of autonomy; on the business side, an early and stepwise business model must be created in which this new development adds to the top line while the existing business continues.

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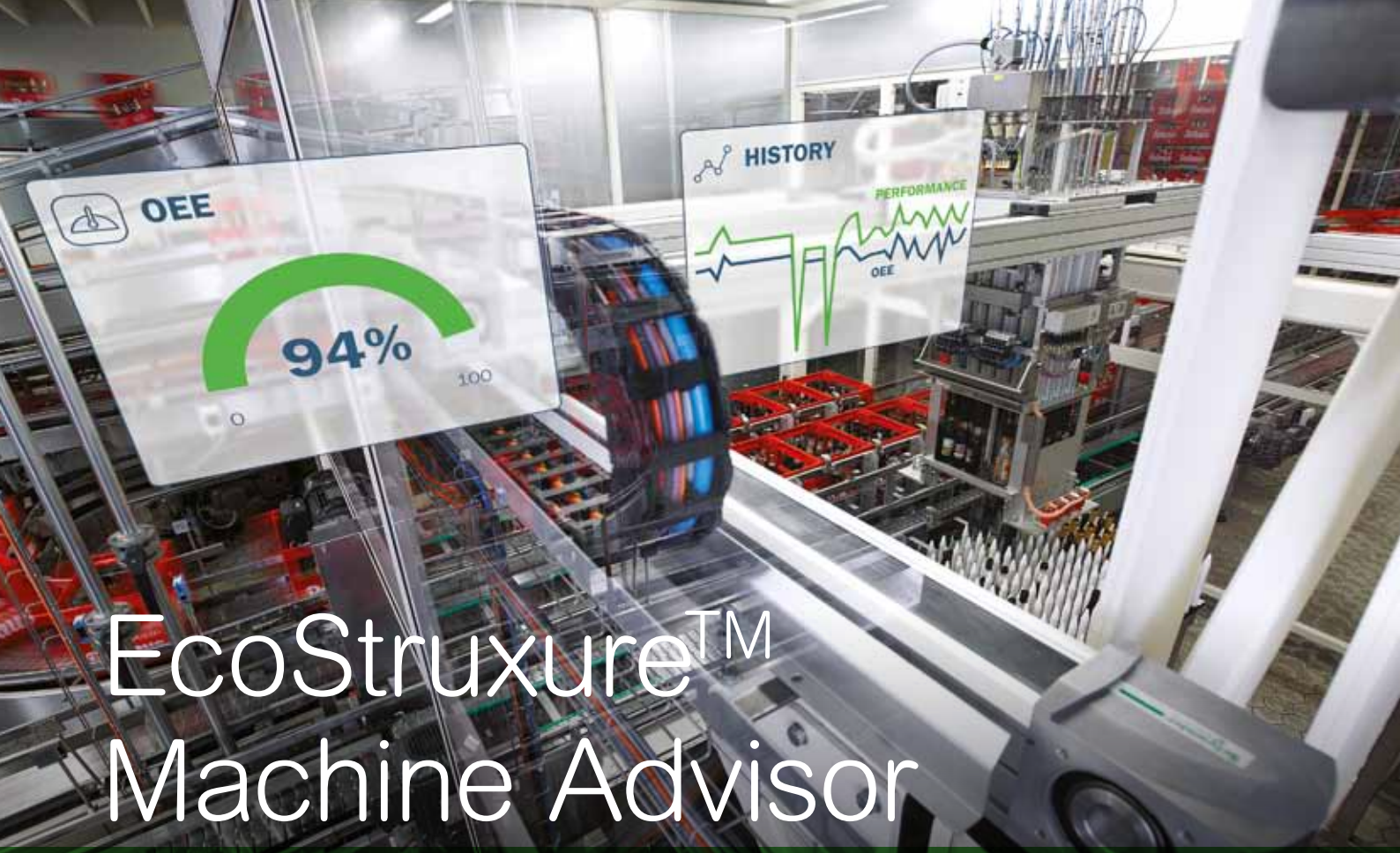

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EcoStruxure™ Machine Advisor is a digital, cloud-based services platform for remote accessing operating machines. It enables machine builders to provide new services to machine operators for each installed machine in any production site worldwide.

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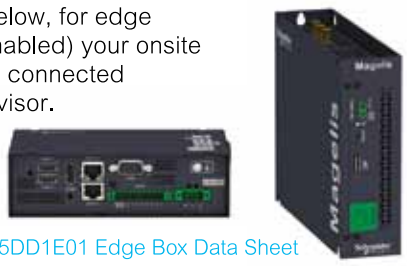

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Go Digital EcoStruxure Machine Advisor

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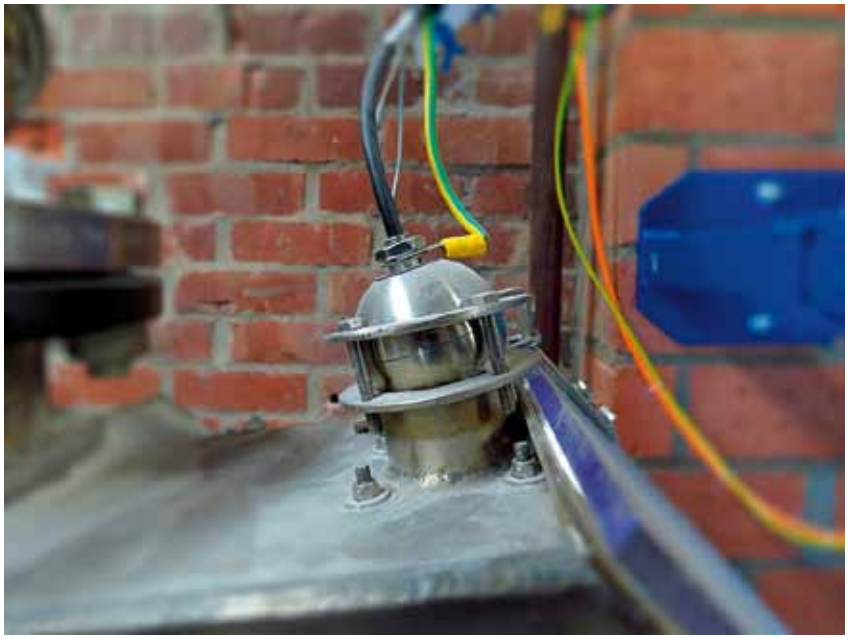
Life Is On | Schneider Electric

Polymer company uses cameras for hazardous process monitoring



Covestro is a producer of advanced polymers operating three different production sites in Germany. Focus is on the manufacture of high-tech materials using the latest technologies, while meeting the highest safety standards.

At the company's facility in Dormagen, one of the substances being produced is the high-performance adhesive DESMOCOLL (a polyester/polyurethane polyol), which is needed for a great variety of adhesive compounds worldwide. The manufacturing process of this adhesive is complex requiring constant control at various production steps, since the medium's state is very volatile.

In three production lines, the product is synthesised in a continuous process under potentially explosive conditions. Therefore, constant condition monitoring is of the utmost importance due to the product's very fast curing times. If the product hardens too rapidly, the result may be unavoidable repair works in the piping system and, consequently, production downtimes.

In the past, on-site inspection and documentation of the production process was carried out by a staff member patrolling 11 particularly critical spots every 30 minutes — a labour- and cost-intensive operation. Simultaneous monitoring of all critical control points was not possible.

As part of automation and to meet the highest safety and security standards, Covestro has opted for a CCTV solution: onsite continuous video monitoring of the production process combined with simultaneous monitoring at a central control centre.

R. STAHL has provided a CCTV system solution for onsite monitoring of these 11 at-risk points using its EC-710 compact cameras for use in hazardous areas. Due to its small and compact design (with a diameter of only 55 mm), the camera has the advantage of being easy to integrate within the inspection window monitoring process. The EC-710 compact camera is ATEX-certified and has been designed for extreme temperature applications, approved for operation in temperatures up to +75˚C and thus fully meets the temperature requirement of +60˚C.

This type of camera is available in different versions featuring seven different viewing angles (81˚ wide to 11˚ telephoto), so that each type of reactor may be provided with an appropriate camera solution. In addition, the CCTV solution integrates visualisation, both onsite and at the control centre, to ensure simultaneous monitoring.

Using hazardous area cameras has helped Covestro significantly reduce staff work and thus labour costs, so that the investment in the CCTV system has produced ROI within a short period of time. Furthermore, continuous monitoring and documentation of all critical points has now become possible. Simultaneous monitoring both at the control centre and onsite now allows for prompt detection and troubleshooting of any critical changes in the medium, thus reducing downtime, preventing repairs, and saving time and money.

The process images of all cameras are displayed on three 24″ HMIs, designed as panel PCs. Images and videos are displayed on these widescreen monitors with 1920 x 1200 resolution in an easily readable size. Due to the simultaneous display of the inspection window images, it is much easier for the staff working onsite to detect any deviations in the process in case of any unexpected changes in the product status. Thus, clumping of the material or even blocked pipes can be prevented.

The overall CCTV system is operated using the video management software SeeTec Cayuga, providing crisp and clear video images on one monitor. With a clear user interface, staff are able to operate the system within a short period of time and to quickly and directly react to any unexpected events, without having to deal with any complex operations. Thus, it represents a good combination of a modern operating concept with tried and tested functionality and ergonomics. In the night mode, for example, colours are changed to improve readability; it is also possible to configure alarm settings, which, in case of an alarm, are activated by keystroke.

The CCTV system in the hazardous area is designed as an open system, making it expandable with further cameras as and when required. Our other explosion-protected cameras such as the zoom or thermal imaging cameras, existing camera types as well as PCs, servers or switches can also be integrated into the system.

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Automating water management for fracking

In the oil and gas industry, technological advances like hydraulic fracturing (fracking) and horizontal drilling have caused a boom in exploration and drilling. The initial 'gold rush' approach to oil and gas development focused on people resources, with most work done manually.

But today, with greater labour uncertainty and higher but volatile prices, investing in automation is starting to make more sense. Increasingly, companies are looking to add automation in the field, especially for water pumping and treatment — key ingredients in successful unconventional oil and natural gas production.

But automation for assets located over a broad area isn't easy.

"Most automation companies don't understand the network piece," said Dan Arbeau, CEO of netDNA in British Columbia, Canada. With his background in automation, wireless, IT support and networks, however, Arbeau was ready for the challenge. He started netDNA in January 2018 and has since added partners for additional capital and resources.

The company's focus is automating natural gas exploration and production, especially drilling. In 2014 Arbeau had automated a large pump for evacuating water from dams, a previously manual system that transferred water for fracking. The customer called again for help with a major project in the Permian Basin in Southern Texas, managing water at hundreds of drilling sites.

Water is essential for successful natural gas production by fracking. The process typically involves water at every step of the process.

" 99% of jobs in the Permian Basin have water pits," said Arbeau. "Water sources are often not close to the drilling site, so water must be brought in. Pits are used to store water, blend water, handle flowback and treat the used water. Until recently, all flow and level monitoring, pump control and the like were typically done manually."

netDNA customer New Wave Energy Services (NWES) provides a range of fracking products and services in the US and Canada, including water transport, modular tanks and buffer tanks. In an industry with remote, widely separated and changeable operations, mobility is essential. So NWES designed large trailer-mounted units for water transfer, typically with four 500–800 hp pumps with 12″ diameter inputs, and turned to netDNA to automate them.

Arbeau had used Opto 22 SNAP PACs before, but the Opto 22's groov EPIC edge programmable controller provides additional communication, visualisation and security features for automation and IIoT projects. For the remote communications and mobile nature of NWE's trailer-mounted units, groov EPIC sounded like the right choice.

Each NWES trailer-mounted pumping unit includes a diesel generator and pumps, controlled by a genset controller that talks Modbus/TCP. Arbeau added a groov EPIC processor and I/O modules on each trailer for additional automation: analog inputs monitor discharge levels and suction, digital inputs monitor flow meters, and mechanical relay outputs open and close pumps via the genset controller.

In addition, the EPIC pulls data from the genset controller, including RPM and associated telemetry, and publishes it to a central broker/server using built-in open-source tool Node-RED and the publish-subscribe protocol MQTT. As of June 2019, six trailer-mounted units were in operation, with several more in the works.

In addition to the trailer-mounted units, netDNA also automates monitoring and control for water pits and tanks. Automating tanks improves safety as well as providing data faster, more easily and more reliably. Tanks are monitored for levels and pumps are controlled to make sure there are no spills. Tanks and pits are also monitored for air quality and hydrogen sulfide (H_2S) levels.

At the pits and tanks, netDNA uses a SignalFire self-contained gateway for wireless sensors. The SignalFire talks Modbus/TCP to a local groov EPIC processor. Each EPIC publishes a variety of data tags from its pumps, again using Node-RED and MQTT. Production data is also tracked and historised. If a spill or issue occurs, producers need to know exactly what the pumps were doing at any given time.

New Wave and its customers are pleased with the results, and Arbeau is pleased with the capabilities of the groov EPIC system.

"Some engine and pump companies are hungry for automation. Some have systems, but they don't communicate with each other," said Arbeau. "EPIC makes them talk."

For the future, Arbeau's dream is a multi-use automation black box: an open-chassis skid with EPIC 'in the middle' and SignalFire connecting to wireless sensors. Arbeau envisions the skid used for projects not only in oil and gas, but also in agriculture, mining and other industries with far-flung assets that need automation and data communications.

For a longer and more detailed version of this article go to: https://bit.ly/349GZR5

Systems 22 Pty Ltd
www.systems22.com.au

OUTDOOR REMOTE MONITOR

The VisuNet IXD remote monitor is said to be extremely robust and comes in a modular design. Whether the application requires a thin client or PC-based HMI, the VisuNet IXD is certified for Zone 1/21 and is optimised for outdoor applications that require an extremely rugged panel PC or thin client with a wide range of interfaces. The VisuNet RM Shell firmware and the user-friendly software tool VisuNet Control Center offer optimised field maintainability.

The housing of the IXD display unit is made of anodised aluminium and is powder-coated. This makes the device safe for water and protects it against corrosion. The VisuNet IXD can operate in temperatures ranging from -20 up to +60°C, and the lightweight technology is globally certified for hazardous locations (IECEx/ATEX Zone 1/21). Intended for use in outdoor applications, the VisuNet IXD has a high-brightness display and an optically bonded touchscreen that reduces reflections, increases light transmission and enables improved picture quality for optimal viewing in high ambient light. An optional sunshield protects from direct sun and can also be used as mechanical protection during non-operation or transportation.

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www.pepperl-fuchs.com

FLUID CONDITION MONITORING UNIT

The CM-Expert Hydraulic (or CME-AU1000) is a fluid condition monitoring unit, providing a packaged solution for hydraulic and lubrication system monitoring.

The unit works by combining air bubble suppression with oil condition sensors and multiple communication options in a single plug-and-play unit.

Installation can be done with minimal impact to an existing system, in both low-pressure and high-pressure systems, as the sensors are protected from pressure and flow fluctuations.

The unit monitors a range of parameters including particle count, absolute conductivity, change in conductivity, absolute dielectric constant, relative change in dielectric constant, saturation level and temperature.

Options include the use of a HYDAC AquaSensor or HYDAC Lab, an LED display on the CS1000 particle counter and various methods of connectivity (Modbus TCP/IP, Wi-Fi and mobile network).

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MOTOR SHAFT GROUNDING RINGS

The ARC EARTHRING is a shaft earthing ring designed to protect electric motor bearings from bearing fluting generated by modern-day variable speed drive systems.

The ARC range of fully adjustable shaft grounding rings is available in both low-voltage (under 400 kW, 600 V) and high-voltage designs, and can be produced to cover all shaft sizes from 20 mm through to 400 mm in 20 mm increments.

The ARC EARTHRINGS protect motor bearings by diverting damaging discharge voltages to the motor frame and not via the motor bearings. Using highly conductive microfibres, including gold clusters, the ARC EARTHRINGS are said to provide optimal bearing protection in harsh and arduous environments.

Sixth Element Australia Pty Ltd
sixthelementaustralia.com

SMART CAMERA

Omron has released the FHV7 smart camera for advanced vision inspections on high-mix production lines. It features a multicolour light and high-resolution image sensor, and is easily integrated into existing systems and machine platforms, and can be combined with robots for picking and assembling applications.

The multicolour light means there is no need to change lighting when product designs are changed or new products are added to the production mix.

The 12 MP smart camera and high-resolution image sensor enables high-precision inspections for wider areas of view, while the autofocus lens covers a focal distance between 59 and 2000 mm.

A dual-core CPU provides fast image processing speed (four times faster than the previous generation). High-speed image logging enables measurements to be conducted while data is being saved.

The addition of external lights and filter replacement are easy, and the camera has a modular structure so users can freely combine the lens and lighting variants. Rated at IP67 for ingress protection, a waterproof hood allows use in wet conditions.

Omron Electronics Pty Ltd
www.omron.com.au

HEAVY-DUTY PAYLOAD COBOT

Universal Robots (UR) has announced the availability of the UR16e cobot, with an increased payload capacity of 16 kg.

The cobot combines the higher payload with a reach of 900 mm and pose repeatability of ±0.05 mm, making it suitable for automating tasks such as heavy-duty materials handling, heavy-part handling and machine tending.

Developed on UR's e-Series platform, the product is said to offer benefits, capabilities and value for manufacturers, including fast and easy deployment with easy programming and a small footprint, as well as the ability to address ergonomic challenges while lowering cost.

The device includes built-in force sensing, 17 configurable safety functions including customisable stopping time and stopping distance, and an intuitive programming flow. It meets demanding compliance regulations and safety standards for unobstructed human–robot collaboration, including EN ISO 13849-1, PLd, Category 3 and EN ISO 10218-1.

Universal Robots

www.universal-robots.com

PRESSURE TRANSMITTERS

Vega has released the VEGABAR 80 series of three pressure transmitters, with which it claims that all conceivable applications can be covered. The VEGABAR 82 with a ceramic measuring cell can cover 80% of all applications, while the VEGABAR 83 with a metallic measuring cell is suitable for high-pressure applications. The VEGABAR 81 with a chemical seal can be deployed when high temperature and chemical resistance are required.

Ceramic measuring cells have many advantages, but also some weaknesses: for example, their susceptibility to thermal shock and moisture. When sudden temperature changes occur, it can take several minutes before sensors with ceramic measuring cells begin delivering reliable readings again.

Vega's CERTEC ceramic-capacitive cell, along with temperature shock compensation, is said to reduce these problems for the VEGABAR 82. In addition to the usual temperature sensor on the backside of the CERTEC cell, there is a second sensor in the glass joint directly behind the ceramic diaphragm that is used to detect thermal shock, allowing it to be compensated by means of an algorithm.

Any two instruments from the VEGABAR 80 range can also be combined into an electronic differential pressure system. A standard VEGABAR 82, for example, can be combined with an additional sensor, selecting the 'slave' electronics version, and connect them together to form a differential pressure system. There are no oil-filled capillary tubes that need to be insulated to avoid environmental influences such as temperature changes or strong vibration and the resulting measurement errors.

VEGA Australia Pty Ltd

www.vega.com/au

CONDITION MONITORING USING THE DRIVE AS A SENSOR

Variable speed drives can be a valuable source of data that can be used for condition monitoring, saving unnecessary expense.

Variable speed drives have been used for over half a century, with the main advantage being the reduction of electrical energy use. With the advance of Industry 4.0 the role of the drive moves from that of a pure power processor to that of an intelligent element of the automation system. The ability of the drive to act as a smart sensor makes it a natural choice when implementing condition monitoring. In this article we present how this can be used in water and wastewater applications.

New drive capabilities for water and wastewater applications

Today more than 20% of all electric motors are driven by variable speed drives. The main reason for using drives is the reduction of energy use; however, there are also other reasons for employing drives in water and wastewater applications, such as process control (keeping constant water pressure, thus avoiding leakage caused by high pressure), avoiding water hammer or optimised well exploitation.

Since the introduction of microprocessors to control the drives, additional functionality has been added to the original function — which is that of a power processor. For example, drives are able to perform pump de-ragging in wastewater applications, they are able to control several pumps in a cascade system in water pumping applications or they can bypass certain frequencies to avoid resonances.

The advance of Industry 4.0 has given an additional boost to these additional functions. As Industry 4.0 deals with information and networking, we can start using the drives as smart and networked sensors.

Industry 4.0 in motor and drive systems

Industry 4.0 is a generic term, suggesting a fourth industrial revolution which can be characterised by networking. Although the term is somewhat vague, a possible definition could be "Industry 4.0 describes the intelligent networking of people, things and systems by utilising all the possibilities of digitalisation across the entire value chain".

The impact of this trend on motor systems is a migration from what is known as the 'automation pyramid' to networked systems (Figure 1). This means that the various elements of the system, such as motors, drives, sensors and controls, get interconnected and also connected to a cloud — where data is stored, processed and analysed, and where decisions are made.

The drive as a sensor

In variable speed drive applications, the availability of microprocessors in the drive and bus communication options, combined with current and voltage sensors, opens new opportunities. Additional sensors (such as vibration and pressure sensors) can also be connected to the drive at almost no cost. This allows the drive to be used as a smart sensor for condition monitoring (Figure 2). The available information offers various use cases, such as system optimisation, energy efficiency optimisation and condition-based maintenance.

Embedded condition-based monitoring

Condition monitoring is a technique to monitor the health of equipment in service. For this purpose, key parameters need to be selected as indicators for developing faults. The equipment condition typically degrades over time. Figure 3 shows a typical degradation pattern, also known as a PF-curve. The point of functional failure is when the equipment fails to provide the intended function. The idea of condition-based maintenance is to detect the potential failure before the actual failure occurs. In this case, maintenance actions can be planned before functional failure, with advantages such as: reduction of downtime, elimination of unexpected production stops, maintenance optimisation, reduction of spare parts stock and others.

Vibration level monitoring

Many mechanical failures, such as bearing wear-out, shaft misalignment and unbalances, create some kind of vibration. As a result, vibration monitoring has been established as the state-of-the-art for monitoring rotating machines. There are various methods of vibration monitoring ranging from basic simple monitoring up to highly sophisticated monitoring[1].

A widely used method is vibration velocity RMS monitoring, which is based on the RMS value of the vibration signal that is measured through a vibration sensor. Many mechanical faults have a significant impact on the RMS of the vibration, such as unbalances, shaft misalignment and looseness. However, the challenge in variable speed applications is the dependency of the vibration on the actual speed. Mechanical resonances are typical examples: these are always present, and a monitoring system has to cope with them in some way. Often the fault detection levels are being set for worst case to avoid false alarms. This reduces the detection accuracy in speed regions where no resonances are present.

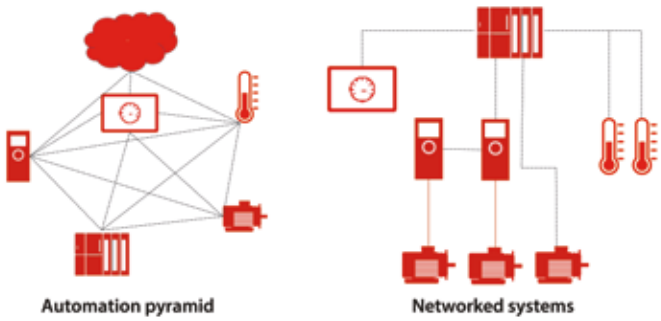

Figure 1: Industry 4.0 means a transition from the automation pyramid to networked systems.

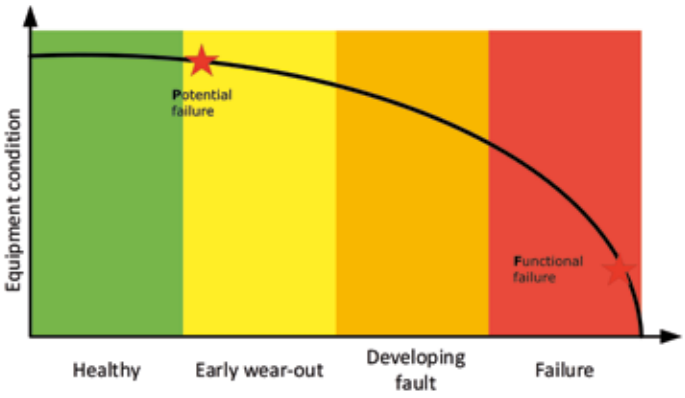

Figure 3: P-F curve representing the condition of a component until functional failure.

Figure 2: The drive as a sensor.

Having a suitable vibration transmitter mounted and connected to the drive, the drive can offer advanced monitoring by correlating the transmitter signal with internal drive signals, such as speed, or other signals that are relevant for the application. The drive can detect faults early and give traffic light info (Figure 3) on the health of the system to prevent functional failure. Maintenance can be prepared and scheduled in advance while the system can continue operation until the next possible maintenance break.

The vibration level in normal operation and in the presence of faults condition is also dependent on the type, location and mounting of the sensor. It also varies with the actual application that is to be monitored, so a learning period is required.

Learning can be achieved in different ways. The first approach is learning the normal vibration levels during the initial period of operation. This means the application is running normally and the drive learns the normal vibration in parallel without affecting the operation. When enough data has been collected, the drive starts to monitor the vibration for variation.

In the second approach, the drive can execute an identification run. Here, the drive controls the motor in a way that enough data is being collected. The possibility of using this second approach depends on the specific application. For example, in a water supply system the pump may not be allowed to run at full speed at the time of commissioning.

Figure 4 shows an example of the results of testing a shaft misalignment. The measured vibration in mm/s versus the motor speed in RMS is shown for two scenarios. In the first scenario the system is in its healthy state. In this state, a baseline measurement is executed. The warning and alarm thresholds are derived based on the measured baseline. For the faulty scenario, a shaft misalignment is created by slightly lifting the motor baseplate. The measured vibration in faulty condition is shown in green.

In this example, the drive can clearly detect this fault. For other applications, the baseline data can be very different. Typically, even in a healthy state the vibration is dependent on speed. There can even by resonance points that need to be taken into account while monitoring. Other types of faults, such as unbalances and looseness, create different patterns.

Electrical signature analysis

The condition of the motor and application can also be monitored through electrical signature analysis. This technique has been under research for many years. The early studies addressed direct online machines, and later variable speed drive applications[2,3,4]. With the available processing power and memory in today's drives, these techniques can now be integrated into drives as features.

In this concept, fault condition indicators can be extracted from the motor currents and voltage signals. Frequency components of currents and voltages can be related to motor or application faults, such as shaft misalignment or stator winding faults. The current and voltage sensors are essential components of drives anyway, as they provide the necessary signals for controlling the motor. These signals can therefore also be used for monitoring purposes. Thus, no extra sensor costs are added. Signal processing and analytic techniques play an important role in this context.

The drive, being the controller of the motor, can correlate the monitored values, like the specific current harmonics, with other available information inside the drive. Knowing the controller state for instance, the drive knows when meaningful spectrum calculations can be performed. Similar to vibration level monitoring, the correlation of monitored values with motor speed, load and other relevant process data (eg, pressure in water pipes) can be performed to get more accurate fault information.

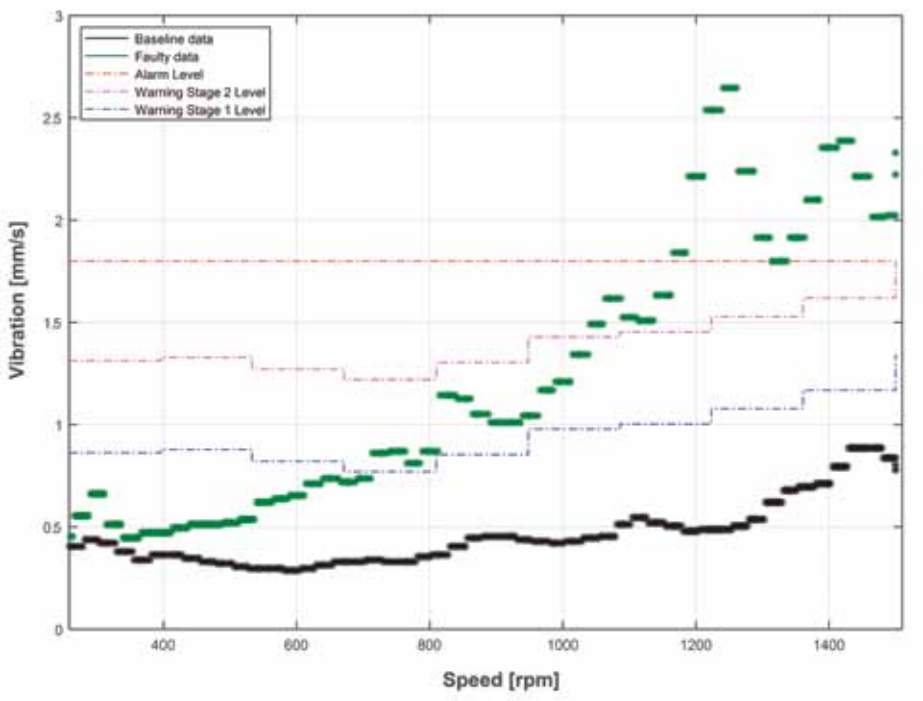

Figure 4: Test data (RMS vibration versus speed) for two scenarios: fault-free (black) and faulty (green).

Load monitoring in pumps

As shown in the previous section, drives are measuring motor current and voltage and the primary purpose is to use these measurements for controlling the motor. The primary current and voltage measurement is used to calculate various parameters such as motor power, energy, actual motor speed or torque. And these values can be used for monitoring the motor load, eg, a pump.

In applications where the load depends on the motor speed, the torque estimation can be used for determining overload and under-load deviations. During baseline the drive 'learns' the normal distribution of the load, or the load envelope, as shown in Figure 5. As in the previous functions, there is a correlation with the motor speed. During monitoring, the drive can detect overload and under-load conditions, which can be caused in pump applications by faults such as fouling, sanding, broken impellers or pump wear.

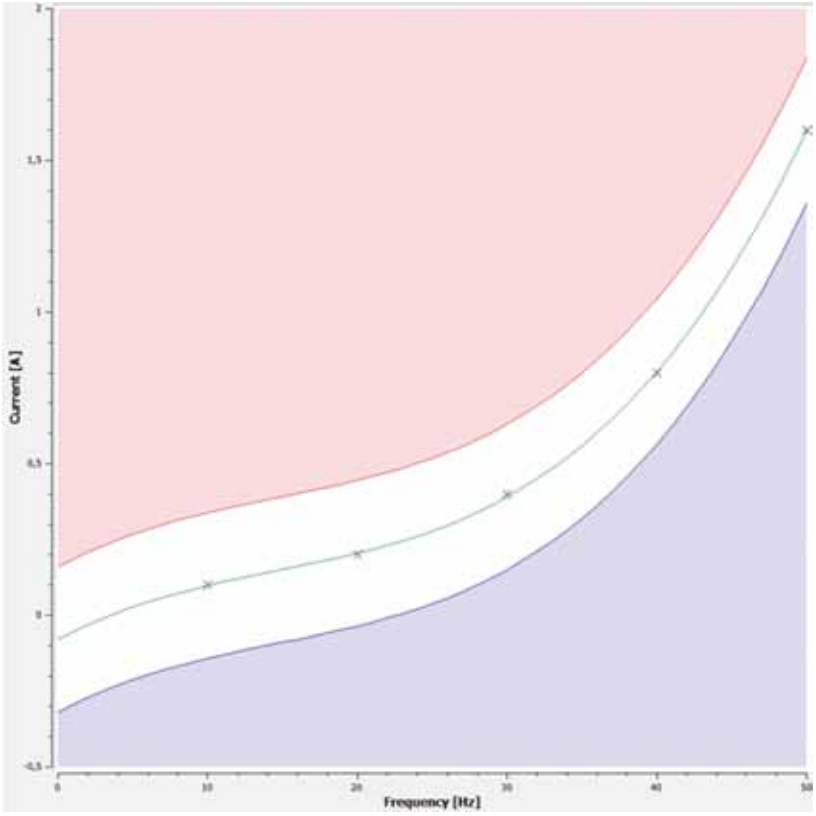

Figure 5: Load envelope curve.

Conclusions

Condition monitoring can be used for implementing condition-based maintenance — which is an evolution from corrective and preventive maintenance. But condition monitoring relies on sensor data; and installing additional sensors can be expensive. However, if variable speed drives are already used in the application, they are a valuable source of data that can be used for condition monitoring, saving unnecessary expense.

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Danfoss (Australia) Pty Ltd
www.danfoss.com.au

MINIATURE PRESSURE TRANSMITTER

The M8cool HB is a high-speed miniature pressure transmitter from Keller designed to measure both static and dynamic pressure. The M8cool features an M8 pressure connection and is designed for media compatibility, as well as supporting measurements carried out at temperatures up to 1000°C when equipped with appropriate cooling.

The sensor features an analog signal path that is readjusted in real time using a high-precision digital compensation circuit. This is to maintain the full dynamic range of the sensor and the accuracy of the measurement signal across 0–50 kHz bandwidth. The series M8cool HB also features a stable silicon sensor backside-soldered to a supporting element that makes it suitable for measurements in fluid dynamics. The dynamic range of 0–50 kHz exhibited by the sensor is supported by a practically flush connection to the measurement media. The micromechanical design delivers absolute measuring ranges of 3, 10 and 30 bar and overpressure protection of up to five times measurement range, while effectively isolating the mounting forces.

The M8cool HB pressure transmitters are suitable for use in high-temperature and hostile environments such as engine test benches, due to their broad operating temperature range. The sensor is insensitive to shock and vibrations and the sensor head can withstand up to 200°C or up to 1000°C cooling. The unit is provided with a Teflon FEP cable with an IP67 ferrule.

Bestech Australia Pty Ltd
www.bestech.com.au

SAFETY MATS

The Pinnacle NSD (New Switching Device) safety mat system provides digital (on/off) switching for safety mat applications.

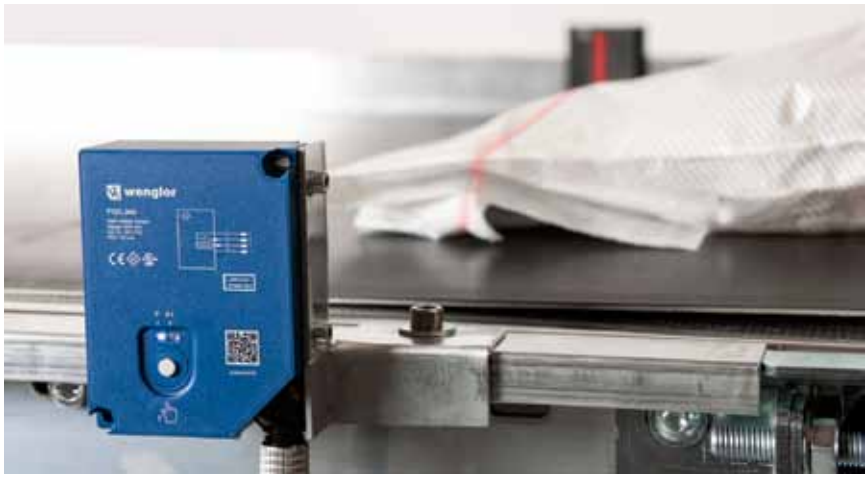
Safety mats are pressure-sensitive machine safeguarding, and are designed to detect the presence of workers on the mat surface area around hazardous machines.

Pinnacle NSD safety mats are designed to be interfaced with safety relay controllers for normally open SPST 4-wire safety mats. A heavy-duty electrode assembly and a durable outer shell provide high impact resilience and the ability to withstand heavy loads.

No rigid steel electrodes are used in the switching mechanism that can rust and dent, and the mats are flexible, preventing shorts, and operational even if it punctured.

The safety relay controllers contain two independent control circuits that allow for shutdown due to any single failure in one of the control circuits. The NO output circuit is controlled by two captive contact relays in series that are both monitored. If the contact in one relay should stick closed, the other relay will shut down and the LED will indicate the fault; if the contact on the bad relay opens back up, the user must reset the power to clear the fault.

Leuze electronic Pty Ltd
www.leuze.com.au



RETROREFLECTIVE SENSORS

Wenglor has released retroreflective sensors with a 27 mm light-band height (P1EL100), a 42 mm light-band height (P1EL200) and 54 mm light-band height (P1EL300). Developed to be two-dimensional light barriers with a homogenous laser light band, they recognise objects with various shapes or perforated surfaces — including dark, transparent or glossy objects — at a range of up to 1.6 m.

They can detect small parts down to 4 mm throughout the entire range of 0–1.6 m due to the use of the collimated, homogenous laser light band. Smart functions integrated into the sensor — such as the suppression of uneven conveyor belt areas through the use of dynamic teach-in and dynamic readjustment of the switching threshold — offer easy application and installation.

In order to avoid inadvertent contact with the teach-in key and to permit flush mounting, the key is located at a slightly recessed area on the housing. External teach-in is also possible via the controller using a 24 V signal.

The sensors combine emitter and receiver in a single narrow housing with a width of 27 mm, which can be mounted to the side panels of conveyor systems in a few steps. The sensor's plug can be rotated up to 180° for flexible installation; matching mounting brackets, M4 through-bolts and press-fit sleeves, as well as reflector sets, simplify precision installation and alignment.

Treotham Automation Pty Ltd
www.treotham.com.au

ELECTRONIC FLOW CONTROL FOR COMPRESSED AIR

EXAIR's EFC electronic flow control for compressed air is designed to minimise compressed air use on blowoff, drying, cooling, conveying and static elimination operations. It combines a photoelectric sensor with a timing control that limits compressed air use by turning it off when no part is present. With eight programmable on and off modes, the timing control permits easy tuning to the application requirements.

For most companies, the air compressor uses more electricity than any other type of equipment. If not properly controlled, one simple operation using compressed air can easily waste thousands of electricity dollars per year. The EFC improves efficiency by minimising compressed air use, resulting in reduced compressed air costs. By turning on the air only when a part is present, it provides just enough air to complete a specific task or operation.

The EFC has an easy electrical connection for voltages from 100 to 240 VAC. With a sensitivity adjustment and ability to detect objects up to 1 m away, the compact photoelectric sensor has high immunity to noise and inductive loads common to industrial environments. The polycarbonate enclosure of the EFC is suitable for use in a wide range of applications including those located in wet environments.

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

SIMULATION AND DESIGN TOOLS

MathWorks has introduced Release 2019b with a range of enhanced capabilities in MATLAB and Simulink, including those in support of artificial intelligence, deep learning and the automotive industry. In addition, R2019b introduces products in support of robotics, training resources for event-based modelling, and updates and bug fixes across the MATLAB and Simulink range. Among the MATLAB improvements in R2019b is the introduction of Live Editor Tasks, which enables users to interactively explore parameters, preprocess data and generate MATLAB code that becomes part of the live script.

R2019b updates to Simulink include the Simulink Toolstrip, which helps users access and discover capabilities as they are needed.

In relation to AI, Deep Learning Toolbox builds on the flexible training loops and networks introduced previously. Users can train advanced network architectures using custom training loops, automatic differentiation, shared weights and custom loss functions. In addition, users can now build generative adversarial networks (GANs), Siamese networks, variational autoencoders and attention networks. Deep Learning Toolbox also can now export to ONNX format networks that combine CNN and LSTM layers and networks that include 3D CNN layers.

In addition to updated features in Robotics System Toolbox, R2019b introduces a Navigation Toolbox for designing, simulating and deploying algorithms for planning and navigation, and an ROS Toolbox for designing, simulating and deploying ROS-based applications.

MathWorks Australia
au.mathworks.com

CONDITION-BASED MAINTENANCE SERVICE FOR DRIVES

ABB has extended the scope of its ABB Ability Digital Powertrain concept that connects drives, motors, pumps and bearings with a condition-based maintenance service option for drives. The option provides the earliest possible warning of any abnormal conditions that might cause a drive to fail prematurely. The service is targeted for drives in critical applications in the oil and gas, metals, water and wastewater, and pulp and paper industries, where it is essential to avoid costly unplanned plant shutdowns.

The Condition-Based Maintenance service continuously monitors key components in a variable speed drive (VSD) — the fans, the semiconductors and capacitors. Thermal, voltage and power sensors collect data on the ambient temperature and load variations of the components and measure the daily impact on their lifetime. Cloud-based algorithms and statistical analysis estimate the level of stress on components and calculate their remaining life.

If failure is predicted before the next planned maintenance operation, management can make a fully informed decision to take action and prevent an unplanned shutdown. In some cases, the Condition-Based Maintenance service could indicate that the drive components are under less stress than normal and will last longer than expected, allowing regular preventive maintenance intervals to be extended to increase productivity and reduce costs.

The ABB Condition-Based Maintenance service is available initially for ACS800 and ACS880 air-cooled drives. The accuracy of the remaining life prediction will vary according to the specific application.

ABB Australia Pty Ltd
www.abbaustralia.com.au

OPINION

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IS 5G READY FOR MANUFACTURING?

High-profile scandals aren't typically good for the technology sector. Whether it's diesel emissions, large data breaches or cyber attacks on mission-critical infrastructure, scandal has the power to cripple a technology even before it's gotten off the ground. Despite what recent headlines may have you thinking, 5G has the potential to be a hugely positive force in the world of manufacturing, heralding in a new era of technological innovation. While 3G and 4G offered incremental improvements in speed and bandwidth, 5G will be the first cellular, wireless platform to truly offer reliable integration with machine-to-machine and industrial IoT systems.

It will do this in three ways. The first is enhanced mobile broadband (eMBB): 5G offers peak data rates of 10 Gbps and can handle 10,000 times more traffic than its predecessors. Secondly, it offers ultra-reliable low-latency communications (URLLC). This means it has a radio latency of less than 1 ms and an availability of over 99.9%, making it ideal for industrial use where uptime is critical.

Thirdly, it offers massive machine-type communication (eMTC), allowing it to handle a density of one million devices per square kilometre. It can also deliver ultra low-cost machine-to-machine communications and can last up to 10 years on battery — great for battery-operated low-power devices.

So, what does this mean for industry? Well, not only will 5G open the door for real-time wireless sensor networks and location and asset tracking, it will also enable plant managers in smart factories to rely on seamless communication with a fleet of AGVs without worrying about network dropouts.

What's more, manufacturers that may have been sceptical of adopting the likes of augmented and virtual reality technologies will be able to take full advantage of them for real-time simulation and predictive maintenance.

In industrial automation, 5G networks will eventually be able to replace wired connections in even the most demanding applications such as motion control and high-throughput vision systems. Ethernet protocols are being standardised by organisations such as 3GPP and IEEE to accommodate time sensitive networks (TSNs) into 5G architecture, which will allow 5G to achieve the low latency and high availability of its Ethernet counterparts.

Making the switch to 5G is not a cheap one, with significant investment needed in upgrading infrastructure to accommodate it. Because 5G operates on the less crowded higher frequency spectrum, around 6 GHz — or by using millimetre waves on new radio frequencies anywhere between 30 and 300 GHz — it can easily be blocked by obstacles and absorbed by the likes of rain and even humidity.

This will require the installation of small cell networks with smaller antennas placed closer together. As a result, one question that we hear all the time is, is 5G worth all the investment in upgrading technology and equipment to facilitate it?

Ericsson, in collaboration with the Fraunhofer Institute for Production Technology in Germany, recently conducted a test in a factory that makes metal-bladed disks for jet engines. The large components are milled in a process that can take 20 hours to complete and involves extremely precise cuts to be made to the metal parts.

The procedure has a high error rate of up to 25% because of faults caused by small vibrations. However, mistakes are not usually detected until the end of the process, leading to a significant amount of wasted time and money. By adding 5G sensors to the machines, achieving data transmission in under a millisecond, Ericsson was able to reduce the error rate to 15%, lowering the overall production cost of each blade by 3600 euros.

The results of Ericsson's test were certainly impressive, but it is important for us to remember that 5G alone will not solve all the problems with inefficiency in our factories.

Manufacturers need to be prepared to invest in infrastructure upgrades — early adopters will face the technical support challenge of retrofitting 5G with existing legacy equipment and networks. This will require work to manage obsolescence and ensure that plants can continue to make productivity gains without overhauling their entire plant machinery and equipment.

There is no doubt that 5G will revolutionise manufacturing as we know it, but it's important that manufacturers understand that it's not a magic pill to solve their productivity woes. That will still require careful obsolescence management, selective infrastructure upgrades and a willingness to explore the features of the new technology in a diverse range of applications. So, despite the scandals, manufacturers should give 5G serious consideration.

Jonathan Wilkins is the Marketing Director of industrial automation components supplier EU Automation. A professional brand advocate and commercial marketing strategist, Jon has been part of the EU Automation team since its humble beginning 10 years ago and has over a decade of experience in marketing.

LASER SCANNER

The Leica BLK360 laser scanner captures full-colour panoramic images overlaid on a high-accuracy point cloud. It is said to be simple to use with the single push of one button and is claimed to be the smallest and lightest imaging laser scanner of its kind.

Available to rent from Tech-Rentals, the scanner offers high-resolution 3D panoramic images and allows users to scan in high, standard and fast resolutions. A full-dome scan (in standard resolution), spherical image and thermal image generation can be achieved in less than 3 min. Its point measurement rate is up to 360,000 points/s and has a ranging accuracy of 4 mm at 10 m and 7 mm at 20 m.

Designed for indoor and outdoor use, the Leica BLK laser scanner has an ingress protection rating of IP54.

TechRentals
www.techrentals.com.au

IoT EDGE SOLUTION

ADLINK Technology has announced the general release of its ADLINK Edge IoT solution, designed to enable industry to gain maximum business value from rapidly deploying IoT technology.

With no programming necessary, ADLINK can quickly connect previously unconnected operational equipment, sensors and devices. Then, by tapping into native communication protocols, data can be captured and streamed at the edge. From the edge, this data can then be streamed securely between devices and databases and to the cloud, enabling analysis and easy visualisation to inform decisions and optimise operations in real time.

ADLINK Edge is deployed via the company's Digital Experiments methodology, which can include hardware, software and support elements for easy integration with existing IT and OT systems. This provides a secure approach to validate business value from the IoT and define a roadmap before investing time and resources in a full-scale implementation.

ADLINK Edge also includes the ADLINK Marketplace, containing apps that are connectors enabling third-party services to translate between devices and applications, or devices and peer devices. Using these apps, IoT architects are free to implement appropriate technologies to solve the particular business problem they face.

ADLINK Technology Inc
www.adlinktech.com

New control system boosts production for animal feed specialist

Rabar is a leading supplier, manufacturer and distributor of commodities and premixes for the animal feed industry. With facilities in Southern Queensland and NSW, Rabar produces custom formulated vitamin and mineral premixes and "macro" mixes both in powder and pellet form.

Established in 1989, the company supplies its extensive range of nutritional supplements to farmers throughout Australia and some products to New Zealand and the Pacific Islands including Papua New Guinea.

For nearly three decades, the company used paper spreadsheets to maintain its batching records and associated data. This outdated system was time-consuming and costly, as well as being prone to inaccuracies and human error.

Rabar turned to Pac Technologies, a developer and manufacturer of industrial automation solutions, for advice.

The brief was simple: how to move from a paper-based records system to real-time data capture and traceability solution? Using equipment supplied by Omron, Pac Technologies created a new batching system for Rabar at its headquarters at Beaudesert, south-west of Brisbane. Omron supplied all the quality control hardware, which was set up and programmed by Pac Technologies. This equipment includes an Omron NX102-9020 PLC and NA HMIs, with Omron V680s RFID hardware in the form of a 3-in-1 RFID system of antenna, amplifier and controller.

For safety, the Omron NX-SL3300 safety system provides a modular safety controller for high-speed, high-precision motion control, and NX I/O provides both standard and safety protocols that enable flexible configuration. Motor control is provided by Omron MX2 VSDs on EtherCAT. The end result is a fully automated system designed for maximum flexibility.

"We achieved everything on the customer's 'wish list' with a customised solution," said Omron Qld and NT Manager Paul Gibb. "We mainly focused on the performance and data processing power of the NX102 in conjunction with NA HMIs.

"This hardware creates a massive amount of value through the data handling capabilities."

Open architecture now gives Rabar the option of using the system integrator (Pac Technologies) for ongoing support as it is not a closed or proprietary system.

Kim Simonsen, CEO of Pac Technologies, said the new batch and data management (BDM) system has streamlined the entire operation.

"The new system has been fully customised to fit Rabar's requirements," he said.

New software now controls the entire blending system from start to finish. It has eliminated manual orders, record keeping and other paper trails.

"The BDM can be configured to work seamlessly with all pre-existing inventory software packages," Simonsen said.

Integrated scales now precisely weigh every ingredient and RFID technology tracks and logs each individual step. The system allows one or a number of operators to work simultaneously on each order, and barcode recognition ensures only the correct products are used.

After nearly 14 months of exhaustive planning and trialling, the new system is now fully operational.

Simonsen said traceability and accuracy in the blending process have improved significantly, and there is no longer a need to conduct a monthly manual stocktake. Stocktakes are now rescheduled on a quarterly basis — delivering a higher degree of accuracy.

Rabar owner/director Gerald Fong said he's more than happy with the new system.

"It has improved accuracy and reduced human error," he said. "Also, production has been boosted by nearly 25% — from 2–3 tonnes per hour to about four tonnes an hour. "The trials have exceeded our expectations. It's a very good result, and we are very happy with the outcome."

Rabar employs 12 production staff at its Beaudesert plant.

"Initially the team was hesitant to move from a manual system to full automation," Fong admitted. "But they have now embraced the change. It's definitely made their lives easier."

And rather than shed jobs with the automation, Rabar will probably need more staff to cope with the expected increase in productivity.

"Already, we have reached a stage where we have exceeded our capacity," Fong said. "But now with the new system we are ready to take on new business when the market eventually recovers from the current drought."

Fong expects the company to receive a return on its investment (ROI) within the next two years. The next stage will be to introduce Omron's LD series mobile robots and TM series collaborative robots for picking and packing products on to pallets ready for dispatch.

Fong said the company is now looking to replicate the new batching system at its Moama facility near Echuca on the NSW/Vic border in the New Year.

Omron Electronics Pty Ltd
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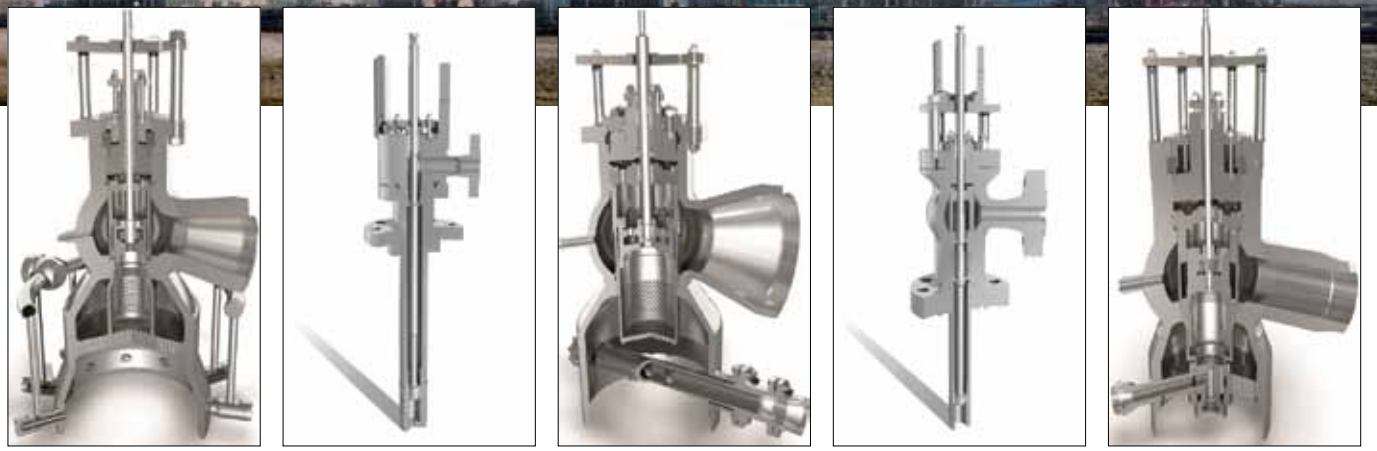

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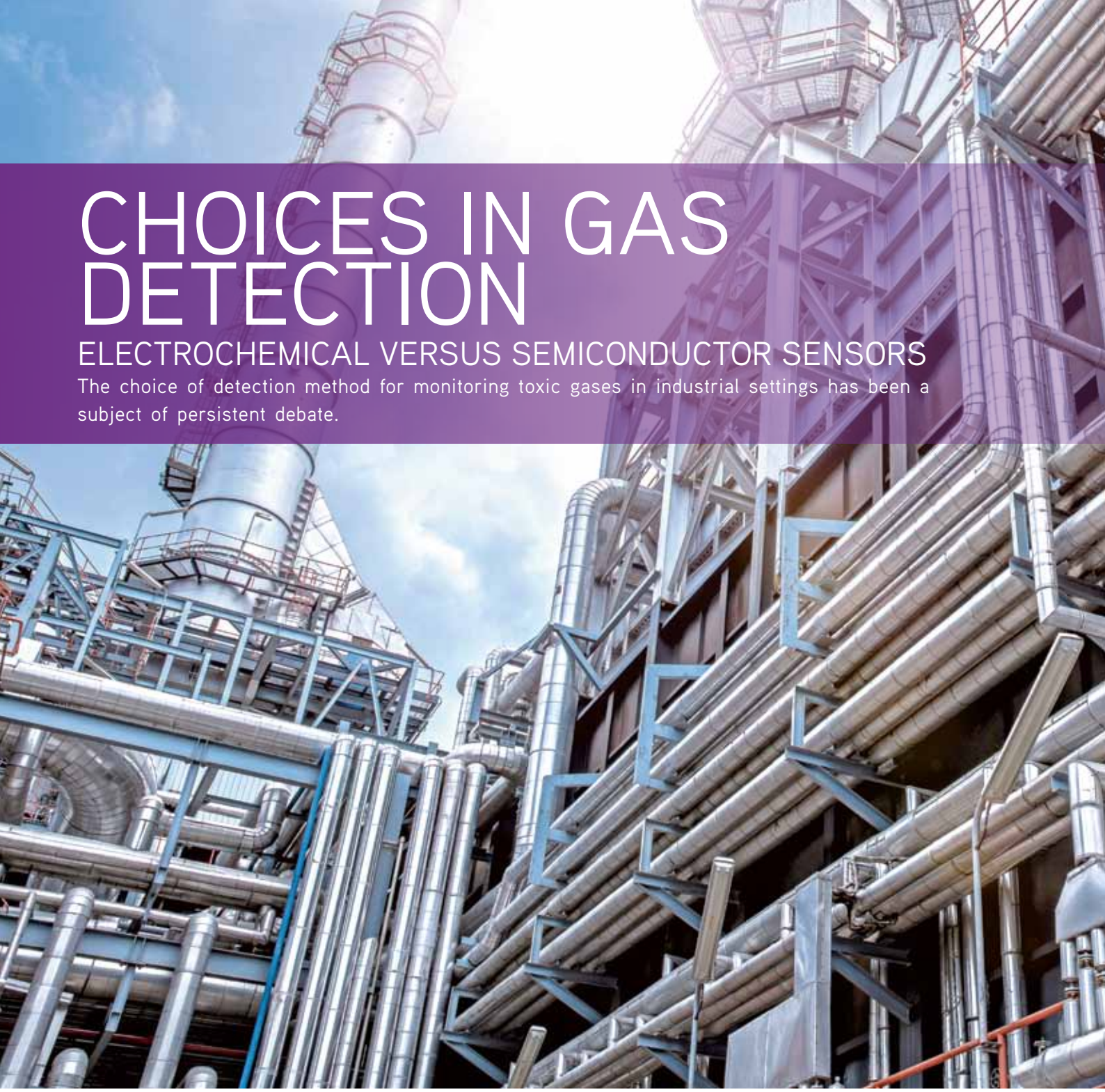
CHOICES IN GAS DETECTION

ELECTROCHEMICAL VERSUS SEMICONDUCTOR SENSORS

The choice of detection method for monitoring toxic gases in industrial settings has been a subject of persistent debate.



Toxic gas monitoring is critical for natural gas power plants, chemical processing, oil and gas production plants, and refrigeration facilities around the world. Leakage of hazardous gases can result in property loss through excessive corrosion, damage to the environment and, most critical, injury and death. Many toxic substances have poor physiological warning properties, meaning people can be overwhelmed by them before being aware of their presence. To protect workers and plant assets, as well as to avert harm to the environment and the public outside of the fence line, organisations use gas detection systems. Toxic gas detection systems have a long history in the workplace and are mandated by law or corporate codes of practice or applied on a voluntary basis.

Among toxic gas detection methods, electrochemical and semiconductor gas detection are most frequently used. Both techniques offer sensitivity in the parts per million, are robust and are suitable for the detection of a wide variety of gases. Yet, despite solid-state sensors' strong contribution to process safety, advances in electrochemical sensor design have led to the broader use of electrochemical gas detection.

Semiconductor sensors

Since the late 1960s, the electrical properties of semiconducting metal oxides have been successfully employed in gas sensing devices. These sensors consist of a gas-sensitive resistive film, a platinum heater element and an insulation medium (Figure 1). Most commercial gas sensors make use of tin oxide or tungsten oxide combined with other oxides, catalysts and dopants to increase the selectivity of the device. Such materials offer high sensitivity at lower reaction temperatures.

When exposed to gas, gas molecules react on the metal oxide surface and dissociate into charged ions or complexes that alter

the resistance of the film[1]. This change is dependent on the physical properties of the metal oxide film as well as the morphology and geometric characteristics of the sensing layer and the temperature at which the reaction takes place. A heater circuit raises the temperature of the film to a range that yields optimal sensitivity and response time to the gas to be detected. Additionally, a pair of biased electrodes is embedded into the metal oxide to measure the change in resistance. This variation of the sensor that results from the interaction of the gas molecules with the film is measured as a signal and is completely reversible. This signal is then converted to a gas concentration.

For reducing gases such as carbon monoxide (CO), hydrogen (H_2) or hydrogen sulfide (H_2S), the surface reaction takes place with pre-absorbed oxygen and water vapour-related species, which decreases the resistance of the sensor. The decrease in resistance as a function of gas concentration is shown in Figure 2. For oxidising gases such as nitrogen dioxide (NO_2) and ozone (O_3), the resistance increases with increasing gas concentration. The magnitude of the changes depends on the microstructure and composition or doping of the base material, on the morphology and geometrical characteristics of the sensing layer and of the substrate, as well as on the temperature at which the sensing takes place. Alterations in any of these parameters allow for the tuning of the sensitivity towards different gases or classes of gases.

Advantages of solid-state sensors

Semiconductor sensors are versatile and long-lived. Typical semiconductor sensors can detect a wide variety of gases and can be used in many different applications. Furthermore, they can do so over 10 years, making their life expectancy among the longest of any detection technology available. Solid-state sensors are also robust and have high tolerance to extreme ambient conditions and corrosive environments, making them a choice for monitoring gases in hot, dry climates.

Limitations of solid-state sensors

When it comes to cost of ownership, solid-state sensors often fall short of end-users' expectations. A weakness of this detection technology cited in the literature is poor selectivity. Many solid-state sensors are affected by methyl mercaptan, chlorine gas, NO_x compounds and other interference gases that alter the sensor reading. This makes the sensor output unreliable and could lead the instrument to trigger false alarms.

Another drawback of solid-state sensors is their high power consumption. These devices rely on a heater to regulate the temperature of the metal oxide semiconductor film because the gas response (or gas sensitivity) of metal oxide films reaches a maximum between 100 and 500°C, depending on the composition of the film and the adsorption and desorption characteristics of the gas on the metal oxide surface. The penalty for such high temperature is the need for a large and constant supply of energy — typically about 1 W.

Solid-state sensors are also prone to baseline shifts over time. As a result, the sensor reading decreases on exposure to the same well-known concentration of target gas, a phenomenon known as the 'sleep effect' (Figure 3). This gradual degradation of the concentration scale is only mitigated by exposing the sensor periodically to the target gas. Invariably, users spend calibration gas at a high rate to keep sensors 'exercised'.

Electrochemical sensors

Electrochemical sensors have been used extensively both for portable and fixed detection systems. For instance, oxygen deficiency sensing can be accomplished entirely by electrochemical means. An electrochemical sensor is an electrochemical cell that employs a two- or three-electrode arrangement and in which concentration measurements can be performed at steady-state or under transient conditions. Depending on the mode of operation, electrochemical sensors are divided into potentiometric, amperometric and electrocatalytic sensors.

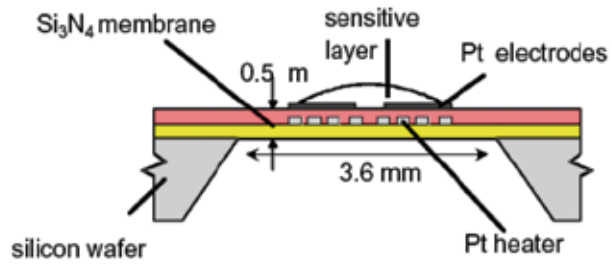


Figure 1: Typical solid state sensor design.

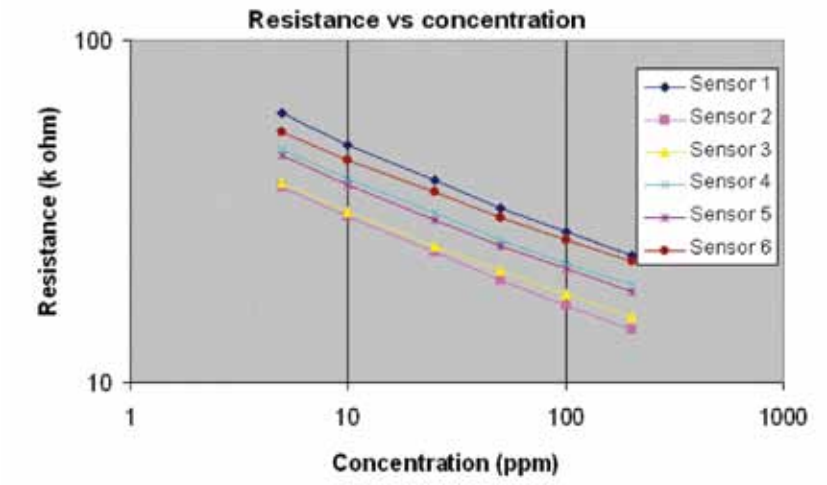


Figure 2: Diagram depicting gas resistance vs concentration.

The most common electrochemical cells are amperometric devices — those in which the current flowing through the system is related to the concentration of the gaseous species. Consisting of a three-electrode system — the working, the counter and the reference electrodes — an amperometric sensor operates at a fixed potential. A schematic of an electrochemical cell with its components is shown in Figure 4. In diffusion-limited conditions, exposure of the cell to the gas of interest results in the production of two chemical reactions. These chemical processes produce a current that is directly proportional to gas concentration.

Advantages of electrochemical sensors

The advantages of electrochemical gas detection in harsh environments are well known. Electrochemical sensors are highly sensitive, consume less power because of their intrinsically safe operation and have good specificity to target gases. The devices have a working pressure range of 10% within atmospheric pressure and, consequently, require no recalibration if used at high elevations. Another advantage is their direct linear output of current to gas concentration. They also offer a real zero.

One striking feature of electrochemical sensors is their capacity for miniaturisation. For this type of sensor, the sensitivity, accuracy and linearity are independent of size. Rather, sensitivity depends on the number of reactive sites of the electrode and the size of the gas inlet.

Limitations of electrochemical sensors

Traditionally, users of gas detection have learned that the drawbacks of electrochemical gas detection stem from the factors affecting the chemical reaction. The speed of reaction, for example, decreases with decreasing temperature. As a result, the temperature range of electrochemical cells tends to be narrower than those of other types of detectors. Historically, electrochemical devices were unable to operate in severe, cold weather. A low ambient temperature limit of -10°C is not uncommon in certain commercial models. These sensors are also adversely affected by alkaline metals, which cause sensor drift, and by silicone vapours, which may coat the sensor surface and irreversibly inhibit sensitivity. Operation in low oxygen environments also alters sensor performance in sensors in which oxidation of the target gas takes place at the sensing electrode. Examples are certain ammonia, carbon monoxide and hydrogen sulfide electrochemical cells.

Advances in electrochemical sensor design

The limited operating temperature range for electrochemical sensors has reduced their use and created a demand for other sensors, specifically solid-state designs. This has led to a "no perfect solution" mindset in gas detection. While detection diversity can be very desirable in many applications, researchers and scientists have worked hard to correct the limitations of the electrochemical sensor.

To address poor thermal stability, researchers have developed cells with ionic liquids (ILs) as the ion conducting phase. Room-temperature ionic liquids are a class of compounds containing organic cations and anions, which melt at, or close to, room temperature. Ionic liquids have low vapour pressures and are stable at temperatures as high as 350°C. Most ionic liquids are surfactants consisting of organic cations such as phosphonium dodecylbenzene, *N*-alkylpyridinium and a variety of anions (eg, SO_3-, Br-). To date, several research groups have demonstrated the use of these novel materials in electrochemical sensors for oxygen, carbon dioxide and ammonia.

The advantages imparted by ionic liquids are evident in an ammonia electrochemical cell. This sensor was found to have a linear response range of 0–100 ppm and a detection limit of 4.2 ppm. Most importantly, the device shows fast and reversible response at temperatures above 75°C. Additionally, IL-based electrochemical sensors can have operational temperature ranges that surpass those of conventional electrochemical cells, even including operating temperature ranges of -40 to +50°C.

If there has been a principal objection towards the broader acceptance of electrochemical sensors, it may be their operation in extreme heat or cold. Yet the thermal stability of these devices has improved over the years and today's sensors operate at ambient temperature limits that approach or often match those of solid-state sensors.

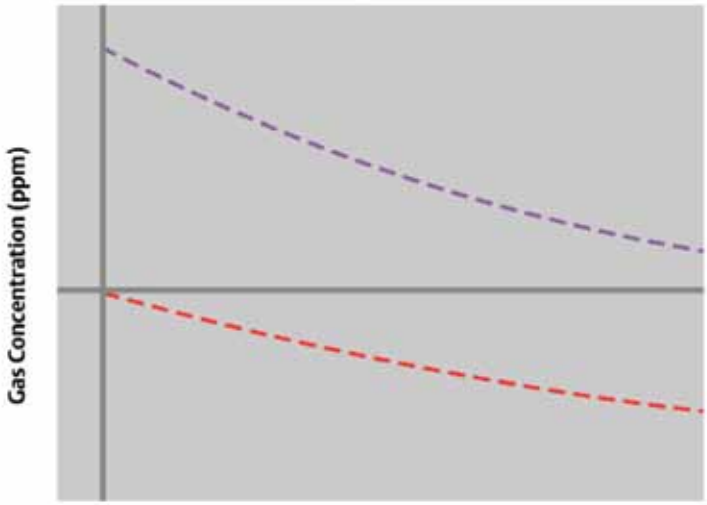


Figure 3: Baseline and span shift of hydrogen sulphide solid state gas detector over time when unexposed to the target gas.

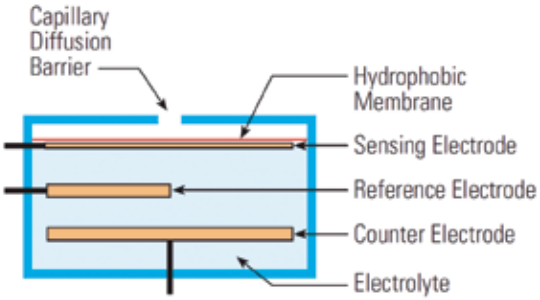


Figure 4: Components of electrochemical sensor[2]

There was a time when electrochemical devices fared poorly in environments with low humidity and had short service lives. In low humidity conditions, cells could dry out and small amounts of impurity gases and other compounds could poison the sensor over time. Over the last 10 years, sensor manufacturers have developed designs that reduce or eliminate these deficiencies. Newer sensors have less porous barriers that limit the number of gas molecules passing through, thereby reducing the amount of moisture collected by the cell. High selectivity has mitigated the effects of poisons and interfering agents, which in turn has improved longevity.

Advanced features for longevity and selectivity

With the evolution of electrochemical detectors, new technologies overcome their traditional weaknesses. An advanced electrochemical gas sensor can now offer high specificity, fast response and low maintenance burden if it includes several of the following features and capabilities:

- Plug-and-play design where the transmitter automatically recognises the sensor configuration
- Triple electrode design using robust materials for sensing, reference and counter electrodes in the sensing
- Low power consumption
- Ability to perform in extreme industrial environments and field-selected gas concentration range to ensure an accurate and stable gas concentration reading
- Operating temperature range of -40 to +50°C
- Operating humidity range of 15 to 90% due to the use of a specialised hydrophobic barrier

The sensor of choice

Today's electrochemical detection systems are sensitive, selective and minimally affected by pressure and temperature changes. Similarly, electrochemical sensors' accuracy, repeatability and response speed do not change significantly with ambient conditions, making them an ideal choice for applications that require repeatability and consistency. Because electrochemical sensors inherently consume little power, they lend themselves well to the design of wireless gas detectors. Some commercial models can operate for more than five years before requiring battery replacement.

A whole host of petroleum companies have long established electrochemical sensors as their preferred method for toxic gas detection. In fact, several corporate codes of practice support electrochemical type sensors as the preferred or only approved method for point H_2S detection.

Conclusion

The choice of detection method for monitoring toxic gases in industrial settings has been a subject of persistent debate — but that argument is winding down. Electrochemical and semiconductor sensors both offer significant benefits, such as accuracy, reliability and ease of use. Despite such common grounds, reduced cost of ownership favours electrochemical sensors over solid-state devices. Electrochemical sensors are highly specific, do not require frequent exposure to target gases and need little power to operate. Such advantages translate to cost savings over the device's useful life.

The significant reduction or even elimination of the narrow operating temperature range of electrochemical sensors has taken away the principal argument for the use of solid-state sensors in their place. While no single sensor will ever be the ultimate choice for all detection applications, today's electrochemical gas sensors are as close to a gold standard as the user is likely to find.

References

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

RFID-CODED SAFETY SWITCH

The PSRswitch is an RFID-coded, non-contact safety switch with a compact design. Integrated RFID transponder technology and intelligence is designed to ensure maximum protection against tampering and safety in accordance with EN ISO 14119. With compatible evaluation units and SAC cabling, it is said to provide a complete solution for flexible safety door and position monitoring for the digital factory.

The PSRswitch provides safe series connection of up to 30 sensors, comprehensive IO-Link diagnostic information with the PSR-MC42 safety relay and protection against tampering with three RFID encoding levels.

The complete Phoenix Contact safety switch system comprises an evaluation unit and the PSRswitch safety switches. The PSR-MC42 evaluation unit can be used as an IO-Link gateway and can be combined with up to 30 safety switches connected in series.

Phoenix Contact Pty Ltd
www.phoenixcontact.com.au

PRESSURE DISPLAY AND LOGGER

The Status Instruments DM670PM is a field-mounted pressure display/logger available in a number of pressure ranges up to 100 bar, and is powered by a user-replaceable lithium battery with up to two years' battery life.

Applications include the general manufacturing, chemicals, brewing and beverage industries.

Features include dual relay outputs for high/low/deviation alarms with adjustable hysteresis and latching. The relay output can also be configured for a battery warning. The device has a 5000-reading integral memory with real-time, date and relay state stamping, user-configurable display scrolling messages and an NFC Android interface for starting a log and downloading logged data via a free app with any Android phone.

The DM670PM also supports simple USB configuration and comes with software and a standard USB cable. It is available in an IP65 stainless housing for wall, surface or direct mounting. Versions are also available for 4–20 mA, voltage and temperature.

W&B Instruments Pty Ltd
www.wandbinstruments.com.au

DEVICE SERVER AND SWITCH

The Westermo L108-F2G-S2-12VDC is a device server with a managed layer 2 Industrial Ethernet switch, powered by the Westermo WeOS network operating system.

Lynx DSS has four 10/100 Mbps Ethernet ports in addition to two ports that can be fitted with gigabit or 100 Mb SFP transceivers and two serial ports. One serial port is configured for RS232 and the other one can be configured for either RS232 or RS422/485.

Lynx DSS is designed for simple use in industrial applications, with a robust DIN rail clip solution, a configurable fault contact and dual power inputs.

Westermo claims the Lynx DSS has an MTBF of 517,000 hours. A wide operating temperature range of -40 to +70°C can be achieved with no moving parts or cooling holes in the case. Lynx DSS has been tested both by Westermo and external test institutes to meet many EMC, isolation, vibration and shock standards for heavy industrial environments and rail trackside applications.

WeOS has been developed by Westermo to offer cross-platform and futureproof solutions. WeOS can deliver 20 ms ring recovery performance.

Westermo Teleindustri AB
www.westermo.com

AIR-MAIN CHARGING SYSTEM

Kaeser Compressors has announced the DHS 4.0 series air-main charging system featuring enhanced control and function capabilities, including the ability to connect to the Sigma Air Manager 4.0.

DHS 4.0 series electronic air-main charging systems provide protection for the compressed air treatment components within a compressed air system, and also help ensure reliable compressed air quality, including after shutdown of a compressed air supply system.

A compressed air network is often depressurised following periods of downtime. As a result there is no flow resistance from the network pressure when the compressors are started. The compressed air treatment components in a compressed air supply system, however, are designed to accommodate the flow rates and speeds that occur in the distribution network when the system is in load operation.

Therefore, without back-pressure present, there is the risk that filter and dryer components may become 'overwhelmed' by the sudden surge in airflow that occurs when the system restarts. This can lead to filter element damage and to a raised pressure dewpoint in the refrigeration dryer. As a result, contaminants such as oil, particulate matter and humidity are introduced into the pipe distribution network and the process air.

DHS 4.0 series electronic air-main charging systems provide necessary minimum pressure, which consequently ensures smooth network start-up and safe operation of the compressed air station.

If, for example, a fault occurs with a dryer or a filter, the air-main charging system is able to shut down and isolate the affected treatment line.

Kaeser Compressors Australia
au.kaeser.com

Tracking down polluters

Proving criminal machinations can be difficult — for instance, when those involved covertly discharge hazardous wastewater into sewers. A new sensor system developed by Fraunhofer researchers and their partners could soon help safety agencies establish wrongdoing: placed in a sewage canal, it detects relevant substances and helps isolate and expose polluters.

There's always one black sheep, and industry is no exception. While the majority of companies dispose of their wastewater properly, a few want to avoid the associated costs, so they quietly and surreptitiously discharge their hazardous wastewater into the sewage canals. By and large, safety agencies currently have no means of detecting this kind of environmental crime on a broad scale — doing so would far exceed their workforce capacity. But this illegal sewage poses major challenges for wastewater treatment facility operators and can even result in turnover of the affected wastewater treatment ponds.

A novel sensor system could soon make it easier for safety agencies to uncover these kinds of offences. The technology was developed by researchers at the Fraunhofer Institutes for Integrated Circuits IIS and for Reliability and Microintegration IZM, together with their partners in the EU microMole project.

"The sensor system is designed to detect certain substances that are typically found in affected wastewater," explained Dr Matthias Völker, group manager at Fraunhofer IIS. "It comprises two sensor components — physical sensors and a chemical sensor — as well as an energy management system, a control and communication system and a sampling system."

If tainted wastewater repeatedly causes problems at wastewater treatment plants, safety agencies could examine the sewage system at certain points and, by taking multiple measurements, gradually close in on and ultimately expose the perpetrator.

To take the measurements, a robot places three rings in the sewage pipe. The first ring is positioned directly in front of the suspect company's inlet and the second directly behind it. Both rings are equipped with a physical sensor for measuring various parameters, such as temperature, pH and water conductivity. The two rings communicate with each other wirelessly and compare the measurement data from their sensors. Differing measurements could be due to hazardous wastewater having been discharged from the premises in question.

The third ring, which is mounted a bit further back in the sewage canal, is equipped with a chemical sensor and a sampling system. If the second ring transmits a special signal, these systems 'wake up'. A micropump withdraws a few microlitres of the wastewater, dilutes it and channels it to the chemical sensor, which features six electrodes that are each coated with a special polymer coating. The unique feature of this system is that these polymer layers contain various gaps that are each perfectly sized to accommodate certain pollutants — much like pieces of a puzzle. When these pollutants bind to the polymer layer, their electrical capacity changes, so when the electrodes sense such a change, it suggests that the wastewater contains certain pollutants.

This cannot be used as evidence in a court of law, so the system also draws a small sample of the wastewater that can then be thoroughly tested by hand in a laboratory. To enable the chemical sensor to be used for multiple measurements, a cleaning solution flushes the attached molecules out again after each measurement.

The sensor system was created in a collaborative effort between several research institutions and other partners. The Fraunhofer IIS researchers developed the electronics, the sensor module's signal acquisition and evaluation, and the system energy supply. Their colleagues at Fraunhofer IZM were responsible for the BUS system on the metal ring and for the design of the waterproof plug contacts for the individual components and the waterproof and chemical-proof casing. They also miniaturised the physical sensors.

The components were first tested individually in project partners' labs, then all together in an artificial wastewater system with real wastewater. In the third step, different components were tested in a real sewage pipe. Initial results are promising.

"The system detected suspect sewage and triggered a corresponding alarm," said Harald Pötter, department head at Fraunhofer IZM. As part of a follow-up project, the Fraunhofer IZM researchers now want to conduct a large-scale test run of the system's physical sensors with partners in five European cities.

Fraunhofer Institute for Integrated Circuits IIS
https://www.iis.fraunhofer.de/en.html

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NEW PRODUCTS

4G INDUSTRIAL ROUTER

Australis M2M has released the MTX-Router-Titan II-R AUS, a 2-port 4G industrial router with two RJ45 Ethernet 10/100 BaseT ports; a USB 2.0 port; M8 rugged connectors for RS232, RS485 and CANbus; and the option of Wi-Fi.

MTX Titan routers include many easy-to-use functions that enable simple M2M/IoT applications. Functional features include gateway server or client, data logging of serial data and automatic data transmission via HTTP/HTTPS, MQTT/MQTTS or FTP. Alarms are available by SMS, and SMS messages can be sent and received via Modbus TCP.

Modbus features include a Modbus TCP/RTU gateway, Modbus TCP/RTU-SNMP gateway, autonomous Modbus data logger, Modbus Slave (sending SMS, emails and SNMP raps via Modbus TCP) and Modbus scripts to enable autonomous actions.

Australis M2M Pty Ltd
australism2m.com.au

SLIMLINE SIGNAL CONDITIONERS

Red Lion slimline signal conditioners have been designed for process signal amplification, isolation and conversion in all industrial environments.

In addition to a large array of input types, the range allows measurement of any temperature, analog or frequency device, while helping to overcome common issues such as long cable runs, poor earthing systems and conversion to industry-standard analog signals.

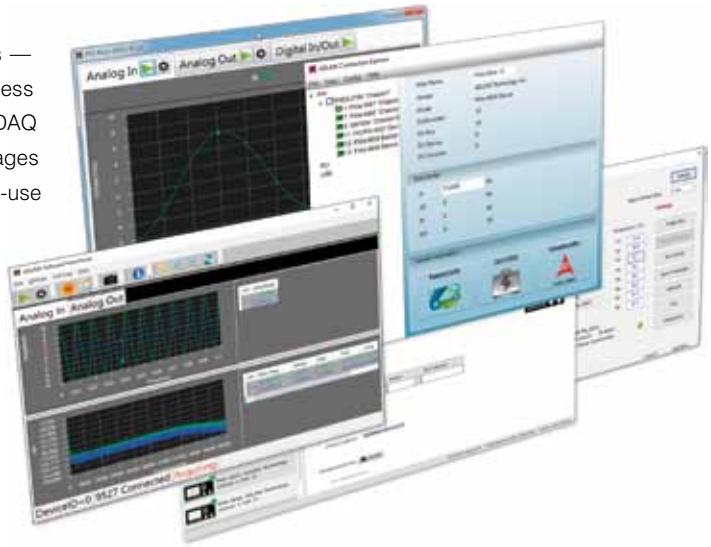
Data can be incorporated into IIoT strategies through the addition of sensors or measurement processes involving precise sensor data requiring signals to be accurately transmitted over distance and without interference from external sources of noise such as VFDs and switching spikes.

Red Lion's signal conditioning and conversion solutions are configured using a programming module for fast deployment repeatability and allow plant engineers to add sensor data to current processes in existing formats, simplifying implementation and lowering costs.

Offered in a 6 mm footprint, each of Red Lion's signal converters can accept or convert current, voltage, thermocouples, RTDs, resistance and pulsed input signals, with low error and high isolation specifications. The Red Lion range carries approvals for FM Div. 2, ATEX Zone 2, IECEx Zone 2 and suitable for mining, water, manufacturing, pharmaceutical, transportation and food and beverage industries.

Control Logic Pty Ltd
www.controllogic.com.au

DEVELOPMENT TOOLS



ADLINK Technology has announced a suite of all-in-one software solutions — its Measurement, Automation, and Platform Suite (MAPS). To improve process efficiency and shorten development time and effort, developers working with DAQ and PXI modules may immediately begin work with MAPS software packages such as ADLINK Connection Explorer (ACE), diagnostic tools and easy-to-use testing utilities to analyse device functionality in one click.

For test, measurement and automation developers, ADLINK Connection Explorer (ACE) is a single quick-access screen for exploring and validating functionality for DAQ and PXI modules, with no back-and-forth searching to determine the root cause of an error installation.

Third-party PXI module developers, developing solutions with platforms such as those from Keysight or National Instruments, may now enjoy full device transparency with ADLINK Connection Explore (ACE), view ADLINK PXI platform and modules on third-party interfaces such as NI-MAX and Keysight Connection Expert, and use ADLINK DAQ modules on NI LabVIEW.

For DAQ module and PXI chassis developers, the MAPS toolset includes Soft Front Panel for DAQ modules users and ChassisWatch for developers using any ADLINK PXI chassis. Both offer easy-to-use testing utilities that analyse functionality in one click for seamless field and site deployment.

MAPS software also offers language-based SDKs needed for C/C++ and LabVIEW developers.

ADLINK Technology Inc
www.adlinktech.com

ISOLATOR AND CONVERTER

The Moore Industries ECT-DIN 2-wire isolator/converter is now available in a narrow 15 mm aluminium housing. The thinner 15 mm width unit has the same general and hazardous area approvals, RFI/EMI protection and -40 to 85°C operating temperature range, which means it can be installed in hazardous locations and does not require installation in cooled or climate-controlled environments, making it suitable for more extreme locations. The narrow 15 mm ECT-DIN signal isolator and converter with 4–20 mA, 1–5 V and 0–10 V inputs and 4–20 mA output allows more isolators to fit in cabinets and field enclosures where installation space is at a premium.

The rugged ECT range provides a range of choices to match the type of AC or DC power available at each location. ECT-DIN 2-wire output-loop powered models, 2-wire input-loop powered models or 4-wire line/mains powered isolators/converters and splitters are available. All units feature solid metal housings that stand up to the continuous, daily rigours of process control and factory automation applications, and have an optional externally mounted flange that provides a secure mount in high-vibration environments.

Moore Industries Pacific Inc
www.miinet.com

STAINLESS STEEL PANEL PC

The Winmate P-Series IP69K stainless steel panel PC with waterproof conduit pipe features screen sizes ranging from 15″ to 23.8″, with P-Cap touchscreen to ensure a user-friendly multitouch experience.

IP69K P-Series Panel PC's stainless steel housing is fully IP69K rated water-, dust- and corrosion-proof, withstanding extensive washdowns with corrosion resistance against cleaning agents.

The custom-built waterproof conduit pipe is preinstalled to give an additional layer of protection for the peripheral cables connected to the device. The included air vent valve comes with an automatic mechanical system to act as a safety device that controls and maintains pressure without the user's assistance in order to avoid air-related problems.

The P-Series offers a variety of mounting options, including panel, yoke and VESA mount, for installation in all the industrial scenarios.

The P-Series IP69K Panel PC is equipped with an Intel Core i5-7200U Kaby Lake processor. The wireless connectivity is also supported for Wi-Fi and Bluetooth for real-time communications and data transfer.

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

PROXIMITY TEST SYSTEM

The Bently Nevada TK3-2E proximity test system simulates shaft vibration and position for calibrating. Available for rent from TechRentals, the TK3-2E probe works by verifying the operating conditions of the monitor readouts, using a removable spindle micrometre assembly. The spindle micrometre is used to check the transducer system and position monitor calibration.

A properly calibrated system ensures that the transducer inputs and the resulting monitor reading are accurate. Vibration monitors are calibrated using the motor-driven wobble plate, alongside a swing arm holder over the plate to hold the proximity probe into place.

The Bently TK3-2E includes 10 probe adapters to accommodate probes of different diameters, adjustable swing arm, variable speed wobulator and a universal probe mount that will fit probe diameters from 5 to 19 mm.

TechRentals
www.techrentals.com.au

ONLINE SHAFT CONFIGURATOR

Designing the right shaft for an application is not easy without CAD software and in-depth technical knowledge. igus has now developed a free-of-charge and freely accessible online tool with the drylin shaft configurator.

The tool allows the user to select the right shaft in the required length, in diameters from 6 to 50 mm from seven materials, machine the main body and the machined ends with standard elements such as chamfers and grooves, and order the configuration. The surface treatment can also be chosen. In addition to hard-coated aluminium shafts, hardened or chrome-plated steel shafts, several hardened stainless steel materials and VA shafts are also offered.

In the second step, the user can machine the shaft body and optionally the machined ends, and add different machining stages as well as 14 standard elements such as bevels, holes, threads or grooves. An intelligent system gives the user maximum and minimum values, which prevents faulty design. The clear surface of the tool, hints and tips make the configuration of the shaft easy for the user.

In the last step, the user gets an overview of the configuration. Here they can request a quote and delivery time, and download the dimension drawing and CAD data of the product. There is also the possibility to save the configuration or to share it with colleagues via a link. After receiving the order, it will be sent digitally to the factory, where the shaft will be manufactured by igus and sent to Australia.

Treotham Automation Pty Ltd

www.treotham.com.au

COMPACT CAMERAS

Teledyne Imaging has announced the latest models in its Genie Nano Camera Link series, the CL M4160 and C4160.

Engineered around Teledyne DALSA's camera platform, and featuring Teledyne e2v's 16M Emerald image sensor, the models are said to offer ease of use and designed for industrial imaging applications that require high-speed data transfer. Users with existing Camera Link systems can take advantage of their compact body size, higher resolutions, greater image quality, faster frame rates and overall lower deployment costs.

The Genie Nano camera series utilise Sony and ON-Semi image sensors, beginning with the 5.1M to 25M models, and now include the Teledyne e2v Emerald sensor models with 16M resolution in C-mount format. Supporting advanced camera features, the series is GenICam GenCP compliant, available in colour and monochrome, and housed in a small form factor for optimised integration.

The cameras offer 4128 pixels x 4128 lines, 1:1 resolution, and a built-in lens shading correction feature to accommodate a lens vignette effect

The camera series is suitable as an upgrade for older CMOS cameras due to its low integration effort.

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BS Punching Systems integrates IO-Link

BS Punching Systems, headquartered near Milan, Italy, offers a range of semi- and fully automated punching machines for tubes and profiles made of sheet metal and steel. The company services customers in the automobile, construction, energy and food industries.

In 2016, development of a new punching machine began. BS Punching systems required a machine that could process two tubes with maximum cross-sections of up to 60 x 60 mm or up to 30 x 120, simultaneously. The new model also needed a flexible changeover concept to allow for quick product changes. The planning, manufacturing and start-up processes also needed to be simpler and shorter than before.

"Our goal was an innovative, compact and versatile Industry 4.0 capable punching machine which offers users maximum flexibility and productivity and saves time and money through faster changeovers to new formats," said BS Punching Systems Head Manager Davide Magnani.

When assessing the brief for the punching machine, project partner Balluff identified an ideal application for IO-Link. The brief called for an inductive distance sensor for detecting the press stroke; a fork sensor for presence monitoring of the workpiece; inductive sensors for position and end-of-travel sensing; valve interfaces and network modules with fieldbus interface — all intelligently connected together.

"For me this was clearly a job for IO-Link," said Balluff's Alessio Tosi.

"Instead of wiring sensors and actuators together in the cumbersome way, IO-Link connects them to the IO-Link using just standardised 3-conductor cable and M12 connectors and thereby to the system controller."

IO-Link enables uncomplicated data exchange between the sensor/actuator and master/control levels. This efficient point-to-point connection is not a fieldbus, but a logical continuation of the previous connection technology for sensors and actuators.

Sensor data and signals are sent to the controller, while parameter values are loaded from the controller into the sensors. Thanks to centrally stored parameter values, format and product changes are simple and quick to accomplish.

Parts delivery with fork sensor

Decisive in selecting the integrated IO-Link solution was Balluff's LED SmartLight stack light. In contrast to conventional stack lights, the colours and zones of the IO-Link SmartLight can be freely controlled and centrally programmed. Up to 20 coloured, stacked LEDs light up or flash depending on the tasks at hand, allowing easy visualisation of the system's operating states.

"Balluff worked with us through the entire development process and expanded our horizon for what was technically feasible with their solid automation expertise," Magnani said.

"Thanks to IO-Link we are delivering our machines faster; our customers are telling us how much they appreciate the high degree of flexibility and the easily implemented configuration and diagnostic features."

Balluff Pty Ltd
www.balluff.com.au

CABINET COOLERS

The Pfannenberg DTT 6000 series of cooling units are claimed to be 100% condensation safe, and feature slim designs for space-saving top-mounted installation on control cabinets.

The repositioning of cooling circuits prevents condensation from forming in the cabinet where the cooling unit meets the enclosure. A widened airflow in the evaporator stops the formation of condensate build-up, with specially engineered return air channels increasing the speed of air leaving the cooling unit to ensure cool air is effectively distributed moisture-free within the enclosure.

Pfannenberg's management system claims greater efficiency, with up to 40% increased heat rejection, durable components, and fast and easy maintenance with a removable cover. A micro-channel condenser design allows for an air path that clogs less and is easy to clean during general maintenance. An optional tool-free quick-release filter mat mounting frame is said to reduce maintenance costs whilst extending the life of the unit.

Control Logic Pty Ltd
www.controllogic.com.au

AS I SEE IT

FEARLESSNESS — THE TRUE DRIVER OF DIGITAL TRANSFORMATION

Digital transformation is a hard-hitting reality for most of us. On the face of it, the principles and applications are simple. Businesses need to adopt data and digital solutions for their processes and ensure engagement of people across the organisation with digital workflows.

But once you delve deeper, you realise that digital transformation is more than just replacing manual processes with digital processes — it's a cultural shift and almost a reimagination of how you run your business to take advantage of the technology on offer.

The elements of the digital transformation process usually involve:

- replacing siloed practices and single-point software solutions with integrated technology platforms that link end-to-end across the entire enterprise;
- unifying separate sets of data and embedded data analytics into user interfaces and workflows to ensure that strategic and tactical decisions are driven by data-based insights;
- increasing transparency through shared applications to improve accountability, accelerate processes and gain the agility to drive (or respond to) market disruption.

So why is it that some companies are facing challenges with adopting a digital transformation strategy?

I think it has a lot to do with mindset.

There are 'leading edge' companies that invent new products and introduce bold new ideas on a regular basis, but the reality is that not every company can be this. Most companies are 'fast followers' that can leverage the innovation of the leading-edge companies by picking and choosing innovations introduced into the marketplace and customise them in ways that make sense in their business. These organisations innovate in incremental steps as they quickly follow the innovators' lead into new markets, leaving behind those who choose to do nothing. But sometimes even the smallest steps can seem like mountains.

For innovation to transform from ideas to reality, a company must foster technology and skills to drive behaviours that promote innovation. Technology is the facilitator to change, but it can't be successful without the right aspirations to succeed.

Digital transformation sometimes feels like it's easier said than done. Having a growth mindset towards how to constantly stay ahead of the game is exciting, but it can also be exhausting, compared to maintaining status quo, if the technology and processes aren't keeping up with the people. It can also be challenging if there are too many barriers associated with costs, complexity and ageing infrastructure.

The need for technology to be accessible, scalable and easy to use is critical in allowing innovation to thrive. The barriers around security and safety also need to be overcome. One key area where I'm seeing change in this regard is in the usage of an industrial cloud-based platform together with a totally integrated factory automation architecture to generate, capture, store and visualise workflow. Technology is there to enable better decision-making through making quality data available in a timely manner. Ensuring good data is readily available helps progress agility so you can fail-forward and be fearless in your approach. Companies need to foster this fearlessness.

Fearlessness is required because digital transformation is not a template that can be copied: it is a unique evolution for each company that undergoes it. It is about selecting the right technology solution and coupling it with the great ideas to be found within your organisation — this is the key to unlocking your potential.

Leonie Wong looks after Business Development in the food and beverage sector for Siemens Australia and New Zealand. Leonie has a control system engineering background. She facilitates ideation and co-creation workshops to help translate the concepts of digitalisation and Industry 4.0 into actionable plans.

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21 ANNIVERSARY

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ATEX IECEx

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