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WHAT'S NEW IN PROCESS TECHNOLOGY
AUTOMATION + CONTROL + INSTRUMENTATION

HEARTBEAT + MINDSET

Can Heartbeat Verification replace Calibration?

In the process industry, performing regular, traceable calibrations on process instrumentation is necessary to maintain the accuracy and reliability of process measurements, whilst complying with all necessary legislative and regulatory requirements.

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However, calibrations can be costly and usually result in process downtime, with a corresponding impact on manufacturing. Failure to calibrate at the correct intervals can result in errors that affect product quality or safety, with potentially major cost implications. To help end users overcome such issues, Endress+Hauser has introduced flowmeters with Heartbeat, an on-board verification technology offering a real alternative to calibration in regulated industries or any other industry in which regular calibration is required.

Whilst there are many instruments on the market today with self-diagnostic features that give the user some level of information about the health of the device, most of them fail to provide traceable evidence that the instrument is still operating in accordance to the original manufacturer's specification. Heartbeat Technology overcomes this by providing a continuous healthcheck of the flowmeter, ensuring key device parameters remain within Endress+Hauser's original specification. Any deviation from factory reference values will be displayed in easy-to-understand diagnostic data, highlighting that maintenance is required or a failure has occurred, in accordance with NAMUR NE 107 and NE 44.

Maintenance programmes Regulatory bodies and standards, including GMP and ISO 9001, define the need for process instrumentation to be periodically calibrated or verified against measurement standards that are traceable to national or international standards; it is the end user's responsibility to determine the correct frequency for calibrating each and every process instrument. The decision on when to calibrate a device can be difficult, requiring the end user to find the right balance between saving operational costs (by extending intervals between calibrations) and ensuring the reliability of the process. The aim is always to minimise downtime whilst maximising plant productivity. To date, if an end user decided to extend the period between calibration cycles, they had to do so in the knowledge that the condition of the device in between calibrations could not be easily verified.

Embedded verification An alternative way to fulfil legislative requirements and massively increase confidence in the installed flowmeters is through on-board verification of the device. The device runs an independently verified on-board diagnostics program where all relevant components of the instrument are checked. This allows the user to confirm and document that the instrument still conforms to the original factory reference values. Verification of an instrument equipped with this self-diagnostic capability can be performed without removing the instrument from the process, therefore reducing the potential for process contamination and the risk of damage to the device during the reinstallation process. It may not even be required to interrupt the process as the verification tests can all be performed in the background. Pass or fail results are available immediately after the test, providing the user with clear information on whether the instrument is still operating according to specification.

Verification report

The verification report is generated directly in the flowmeter and provided as a tamper-proof PDF file.
The file can be accessed directly via a web server or downloaded remotely through a DCS or asset management control system.

Independent validation TÜV, an internationally respected certification body, has independently validated Endress+Hauser's Heartbeat Technology and has concluded that the result of this on-board verification technology is every bit as valuable as a wet calibration. Utilising devices with Heartbeat allows users to significantly extend calibration cycles, reducing operating expenditure whilst ensuring the process remains fully compliant.

A key benefit of Heartbeat verification is that it can be initiated locally or remotely with minimal effort. The procedure is usually completed within a few minutes, which means that the verification can be easily performed on a daily or batch-by-batch basis, significantly increasing the confidence in the flowmeter and its ability to precisely measure necessary components. Following a Heartbeat verification, the device generates a report that can be downloaded in PDF format for storing or archiving, with the last eight verifications stored inside the flowmeter transmitter.

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WHAT'S NEW IN
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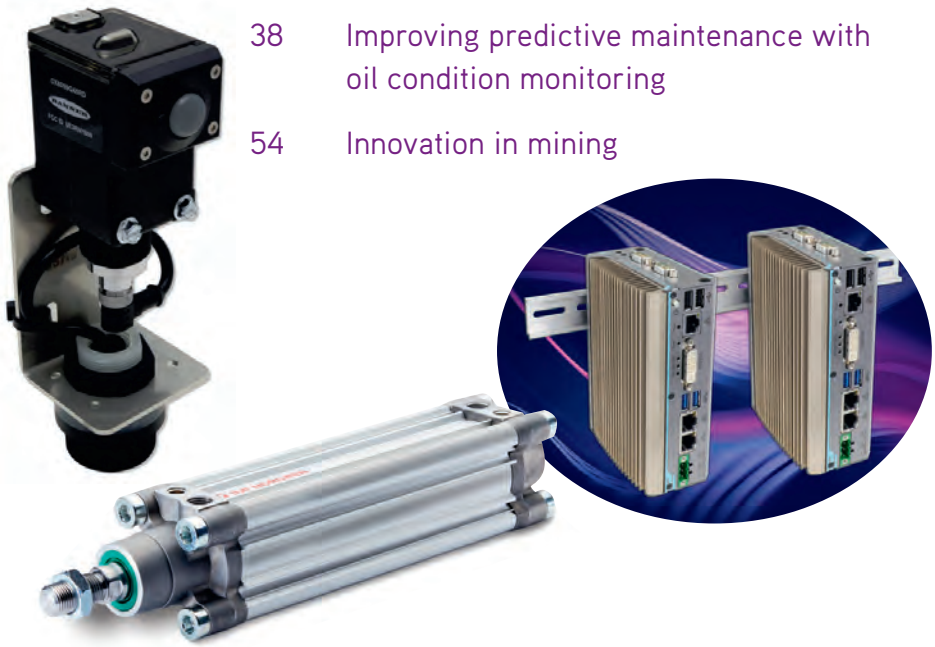

ON THE COVER

The ST100 is a thermal dispersion technology gas flow meter from Fluid Components International (FCI) that combines the most feature- and function-rich electronics with the industry's most advanced flow sensors to achieve a truly state-of-the-science flow metering solution for industrial processes and plant applications.

The ST100 series transmitter is unsurpassed in meeting current and future need for outputs, process information and communications. Whether your output needs are traditional 4–20 mA analog, frequency/pulse, alarm relay or advanced digital bus communications such as HART, FOUNDATION Fieldbus, Profibus or Modbus, ST100 has you covered. ST100's bus communications have been certified by, and are registered devices with, HART and FOUNDATION Fieldbus. In addition, Emerson Process (Delta V), Yokogawa and ABB (800xA) have tested and verified ST100 Series' FOUNDATION Fieldbus interoperability with their systems. What's more, should you ever need to change or upgrade, the ST100 can be converted to any of these outputs with a simple card change in the field. ST100's display brings new meaning to the term process information. The graphical display provides the most comprehensive information on the process measurements and conditions of any thermal flow meter available, making the ST100 the true face of accuracy in thermal flow technology.

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AMS

THE UNDISCOVERED COUNTRY

THE FUTURE OF INDUSTRIAL AUTOMATION – PART 1

*Paul McLaughlin and Rohan McAdam, Honeywell Process Solutions**

The Industrial Internet of Things (IIoT) has the promise and potential to be the most influential and disruptive influence on automation systems since the advent of microprocessor-based distributed control systems. Additionally, the question of how the conventional Purdue model for automation systems, and today's installed base, fits with new IIoT architectures is examined.

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The Industrial Internet of Things is the intelligent application of digital technology to solving the automation needs of an analog world. IIoT could equally be called the Intelligent Internet of Things. There are two fundamental pillars to IIoT: digital automation systems, and the internet itself. Although current DCS and discrete manufacturing systems have been described as IIoT solutions, they are not true IIoT systems without the internet, and internet cloud-based technology.

The Internet of Things

The development of the internet over the past three decades has led to connectivity between people, organisations and businesses on a scale that would have been difficult to imagine when it first emerged in the 1980s. This ubiquitous connectivity is rapidly extending beyond people to 'things' as all manner of devices, sensors, controllers and actuators become connected in what is now referred to as the Internet of Things, or IoT. However, simply connecting vast numbers of objects from daily life into an Internet of Things is not sufficient to enable interesting and useful new ways of living and doing business unless there are platforms, tools, algorithms and applications to analyse, distribute and act on the huge amounts of data that result from this connectivity. Consequently, the IoT, as it is currently understood, lies broadly at the intersection of ubiquitous device connectivity, cloud storage for the very large amounts of data produced, statistical and machine learning algorithms for analysing and acting on that data, and new human computer interaction technologies provided by mobile and wearable computing devices.

The emergence of IoT

The IoT has its roots in the early 1970s and can be considered to have an epoch date of 1969, the year that the internet itself (then ARPANET) was first deployed, and when UNIX was released by Bell Labs. Given the premise that IoT is based on the harmonious alignment of the internet to smart digital sensors and devices it is clear that ARPANET and modern industrial control systems are foundational pillars of the IIoT concept. UNIX is foundational as well, as it formed the underlying basis and structure for client-server computing, workstations, personal computing, server farms and virtualisation.

Evolution of these core systems has yielded smart, internet-connected sensors and ubiquitous computing that weave computing into every aspect of life by allowing it to occur anywhere in formats that make sense in any particular situation. But the current IoT landscape is characterised by a large number of emerging application areas and supporting technologies, many of which are still in the early stages of development. Nonetheless, the confluence of technology coming together in IoT approaches does enable new sorts of applications and business models that will undoubtedly create new markets and disrupt existing markets.

The Internet of Things has, to a large extent, been enabled by the rapid emergence of a series of technology inflections. These technologies are virtualisation, cloud computing, pervasive networking, big data analytics and machine learning, smart devices and device mobility. These technologies enable the new types of systems typical of what is recognised as the IoT.

Virtualisation

Virtualisation technology that allows software workloads (entire operating systems, individual applications, etc) to be decoupled from the hardware on which they run allows a range of deployment scenarios that can significantly reduce cost, simplify management, improve availability and avoid problems associated with churn in the underlying hardware platforms. Virtual deployment of computing resources can be either on-premise or off-premise.

Cloud computing

Cloud computing provides virtualised platforms with elastic compute and storage capabilities. Cloud platforms are usually run as a service based in large data centres that make it possible to easily acquire additional computational and storage capacity as it is needed. This can entirely remove the need for a software-based enterprise to acquire and manage their own computing infrastructure.

Pervasive networking

More and more devices, in the consumer, commercial and industrial markets, come equipped with some form of connectivity. This connectivity can take the form of direct internet connectivity via 3G and 4G cellular networks, indirect internet connectivity via Wi-Fi, or local connectivity via Bluetooth or near-field communication. This allows devices to participate directly in cloud-based services or indirectly through gateway devices such as a smartphone that is connected to a cloud-based service. Pervasive networking provides opportunities for establishing relationships between elements of the physical world that do not exist otherwise, enabling a range of new applications and services.

Big data analytics and machine learning

The elastic compute and storage provided by cloud computing together with pervasive networking makes it possible to collect very large amounts of data from an increasingly wide range of sources. Collecting lots of data about a lot of things (big data) provides opportunities for analysis of phenomena not possible otherwise. Big data is characterised by a large volume of data (in the order of terabytes and petabytes) that requires new techniques to store and analyse, such as massive parallel data stores and statistical techniques or identifying correlations and patterns in data. The availability of data for analysis has also spurred the application of machine learning techniques including artificial intelligence algorithms to the big data stores as well.

Smart devices

Not only are devices becoming more connected, they are becoming smarter. The availability of small, low-power processors that can be embedded in many devices allows them to act as more than mere sensors or actuators. Local computational resources allows devices to act on their local environment becoming more interactive and autonomous. The trend towards increasing connectivity and capabilities in a wider range of finer grained smart devices is also known as ubiquitous computing. The aim of ubiquitous computing is for computers to blend into the surroundings so that they become an integral part of the physical and virtual world that are available when needed without having to explicitly use any form of conventional computer interface.

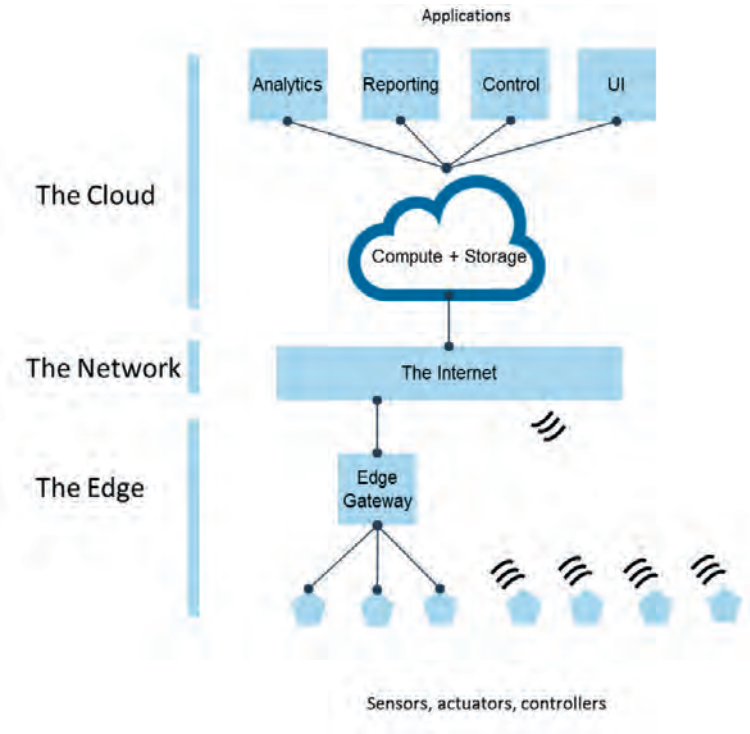

Figure 1: IoT architecture.

IoT architecture

The technologies outlined above come together in a general architecture that consists of three main domains — the cloud, the network and the edge — as illustrated in Figure 1.

The cloud includes compute and storage mechanisms together with applications including analytics, reporting, control and user interfaces. The user interfaces may actually live at the edge and are often combined with sensors, as in the case of smartphones. Network connectivity is built on IP-based protocols, some of which are conventional protocols such as HTTP with others being more specialised protocols designed specifically to enable IoT-based applications involving large amounts of data collection and distribution.

The edge consists of the 'things' in the IoT such as sensors, actuators and controllers. In some cases these devices are connected directly to the network via 3G/4G cellular or Wi-Fi. In other cases an intermediary — an edge gateway — provides connectivity to one or more devices that support only local connectivity.

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Mobility

One area where smart devices are making a very large impact is in the area of mobile computing. Smartphones and tablets enable a wide range of highly interactive context-sensitive (location, time, task, etc) applications. However, the current trend is towards disassembling the smartphone and distributing its capabilities across a series of smart wearable devices. The current crop of smart watches and head-up displays are a good example of this.

The Industrial Internet of Things

As noted in the previous section, the core ideas of the IoT have broad applicability. The Industrial IoT is, in broad terms, the application of these ideas to the planning, running, analysis and optimisation of industrial enterprises. The application of these ideas to industry is being developed in a number of initiatives such as Industry 4.0 and the Industrial Internet Consortium, and aims to bring together the means of production (the physical plant) with the advanced internet-based computational and analytic capabilities to create cyber-physical systems that transcend the capabilities and scope of current automation systems. In simplistic terms, the IIoT connects the world of industrial things (sensors, actuators, controllers, robots, etc) to computational capabilities residing in internet-based storage and analytics.

IIoT vs IoT

IIoT differs from the more generic concept of the IoT with respect to several key quality requirements that result in architectures that expand on IoT approaches. A fundamental difference is that IIoT aims to enhance the operation and management of industrial production processes, many of which involve exothermic reactions for which safety is a primary concern. Security of IIoT-based systems is also of paramount importance not just from a safety perspective, but also in cases of the production of essential and

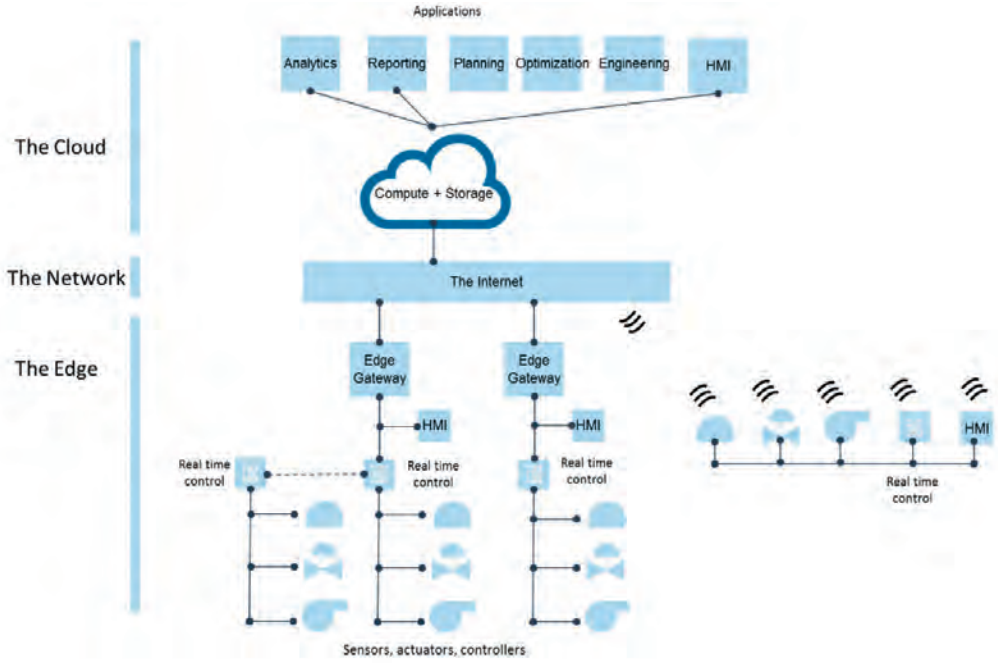

Figure 2: IIoT architecture.

strategically important goods and services. This results in more stringent security, reliability, availability requirements and the ability to continue operation with intermittent access to internet resources. When failures do occur, the system must continue operation where possible or degrade gracefully, deterministically and safely.

Another fundamental difference between IIoT and consumer applications of IoT is that an industrial plant is a very long-lived, capital-intensive asset requiring long-term support in the face of rapid technological advances. This requires support for existing, often ageing equipment and infrastructure and a means of protecting investments in intellectual property concerning the planning, execution and optimisation of production activities. In contrast, other applications of IoT involve short product life cycles that are often driven by whims of fashion and budget. Consumers are willing to rip and replace to get improved functionality. On the other hand, it is very expensive to shut down an industrial process to replace or upgrade equipment. Instead industrial enterprises favour keeping things running as long as possible — as exemplified by the huge spare parts business for obsoleted systems. One consequence of this is that many devices that will form part of the IIoT will continue to communicate via existing, often old protocols and will need special mechanisms to integrate them into the wider IIoT environment.

Many applications of IoT are human-centred — in which information delivery and interaction is aimed primarily at human users. The IIoT, on the other hand, focuses on automation of industrial processes with a trend towards less manual human involvement in production. Human participation is still a key element, but increasing levels of automation continue to move the human participants in an industrial enterprise away from direct control of the process towards higher level planning and supervisory roles. The ultimate goal of IIoT might be considered completely autonomous 'lights out' operation over an increasingly large scope of production from the autonomous operation of individual units today to the autonomous operation of an entire site or collection of sites in the future.

IIoT architecture

A large DCS is a complex network of sensors, actuators, controllers and computational capabilities. The lower layers of a DCS tend to be autonomous with responsibility for the real-time control of the process and can operate with a high degree of safety and reliability. The layers above provide various supervisory capabilities including advanced and supervisory control, and HMIs for management of the process by human operators. Above this are facilities for capturing and analysing a continuous historical record of the process and tools for planning and scheduling production activities that are passed down to the lower layers for execution.

It is tempting to draw a direct comparison between the DCS of today and the IIoT-based automation system of the future and claim that we are already doing IIoT, but to do so ignores the significant changes to the DCS (as we understand it) that will occur with the introduction of the IIoT. The IIoT arises from the combination of core DCS concepts such as local, high-availability, real-time control of industrial processes together with the technologies and architectures that enable the IoT.

In the case of the IIoT, the applications running against cloud-based storage include applications geared towards industrial enterprises such as planning/scheduling, optimisation and engineering.

This model provides an overview of the general structure of IIoT-based systems. This is not a one-size-fits-all model. There will be variations on this architecture for specific types of systems and sites. In some cases the cloud environment may be deployed on-premise (either at the site or in the organisation's data centre).

One of the main differences between IoT and IIoT architectures concerns the nature of the edge computing environment. In the IIoT the edge computing environment provides the opportunity to address key requirements in the areas of performance and robustness needed in industrial process control. Another significant characteristic of the edge computing environment in the IIoT that sets it apart from the IoT is a high degree of heterogeneity in the devices used and the protocols with which they communicate.

In Part 2

In Part 2 of this article we will look at the IIoT architecture in more detail, and how it can be reconciled with the Purdue Enterprise Reference Architecture Model.

**Paul McLaughlin is Chief Engineer at Honeywell Process Solutions. He has worked in the automation industry for 35 years and been with Honeywell for the past 30. Paul is currently responsible for the development of the HPS Industrial Internet of Things strategy, and has degrees in mathematics and computer science from the University of Delaware and the University of Pennsylvania.*
**Rohan McAdam is Chief Architect for Honeywell Process Solutions. He has worked in the field of industrial process control since 1988. Prior to joining Honeywell in 1993, he worked in the alumina industry in Western Australia, and has a mathematics degree from Charles Sturt University, a master's degree in cognitive science from the University of New South Wales and a PhD in computer science from Charles Sturt University.*

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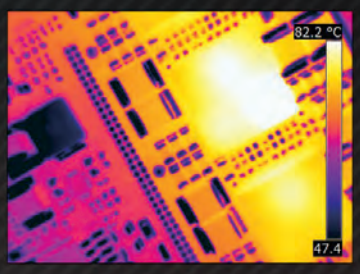

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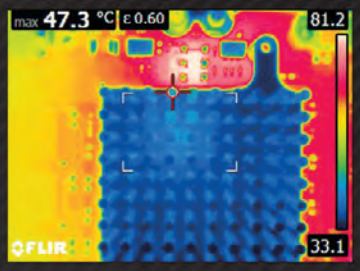

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OPINION

INDUSTRY 4.0 — THE FOURTH REVOLUTION

Industry 4.0 (the 'fourth industrial revolution') refers to the current trend towards improved automation, machine-to-machine and human-to-machine communication, artificial intelligence, continued technological improvements and digitalisation in manufacturing. As such it builds on the digital revolution, representing new ways for technology to become embedded within societies — and even the human body. The fourth industrial revolution is marked by emerging technology breakthroughs in a number of fields, including robotics, artificial intelligence, nanotechnology, biotechnology, the Internet of Things, 3D printing and autonomous vehicles.

This trend is enabled by four key drivers: rising data volumes, computational power and connectivity; the emergence of analytics and business-intelligence capabilities; new forms of human-machine interaction, such as touch interfaces and augmented-reality systems; and improvements in transferring digital instructions to the physical world, such as robotics and 3D printing.

Industry 4.0 is now a globally accepted reality that is affecting almost every industry across the world and is rapidly transforming how businesses operate. But what does this buzzword actually mean? For a better understanding it is worth examining the three preceding industrial revolutions, as they also brought fundamental changes to manufacturing processes.

In the middle of the 19th century, thermal engines made it possible to supply large factories with energy at any location. Starting in Great Britain, this fuelled a massive change in the industrial landscape from small workshops to huge factories — the first industrial revolution, which can be defined as mechanisation.

The second industrial revolution began in the early 20th century in the USA. Conveyor belts led to a considerable increase in productivity and made products that were previously reserved for very few people accessible to a mass market. The Ford Model T is of course one of the most famous examples of this development which established mass production.

From the middle of the 1970s, the increasing use of microelectronics and computers, coupled with CNC control systems, resulted in a significant increase in automation in production, which today is referred to as the third industrial revolution. It was then possible to automate flexible manufacturing processes.

The computerisation of production has advanced in leaps and bounds in recent years. Ever more complex manufacturing steps can be automated, therefore, permanently increasing productivity. This is also reflected in customer demand. The desire for individualised products is becoming ever greater — for example, consumers do not just want completely individual automobiles, they also want muesli and shampoo to be individualised according to their own specific taste. In addition, we are seeing a significant shortening of product life cycles. All these trends have a huge effect on automation technology. Systems must be able to manufacture small batch sizes with greater productivity; the conversion of a production system to a new product range is becoming more frequent; value chains between different producers are becoming more complex and therefore more prone to faults; and it is essential to avoid downtimes.

It is apparent that efficient solutions involving increased networking and intelligence of the systems will need to be found in order to deal with the increasing complexity associated with these demands. This is referred to as the fourth industrial revolution — the Internet of Things. The classic automation pyramid in which data from the field level passes through various levels up to the control level and is then gradually aggregated is breaking down. Instead, the data is available on all levels and can pass directly to a private or public cloud.

It will no doubt take a number of years before Industry 4.0 has become fully established and a huge amount of work will be required beforehand, especially with regard to standardisation.

One key factor for its implementation is the availability of data. For a sensor system manufacturer such as Leuze electronic, most of the data is generated in our products. However, simple sensors usually provide the user with only a fraction of this information.

The IO-Link interface, however, creates a first step toward Industry 4.0. Process, configuration and diagnostic data becomes

available and can be exchanged with the control system. To achieve true Industry 4.0 implementation, however, data does not only need to be made available in the control system but has to be available at every level — even all the way up to the cloud. An IO-Link field master device can be used for devices without the appropriate interface. Via its fieldbus interface, the field master transfers the data to the control system either via Profinet or EtherNet/IP. At the same time, however, the data is also transferred via a web server and is available for other purposes such as diagnostics — an important step today toward tomorrow's Industry 4.0.

Hafiz Rahman is the Managing Director of Leuze electronic Pty Ltd (Australia/NZ). He has been involved in the industrial switchgear and automation field for over 30 years, starting as an application engineer at Square D. He has worked in various roles, from product management through to technical and other management responsibilities, during this time. Hafiz has many years of experience in the safety, sensing and automation industry, and has an educational background in electrical engineering from Swinburne University.

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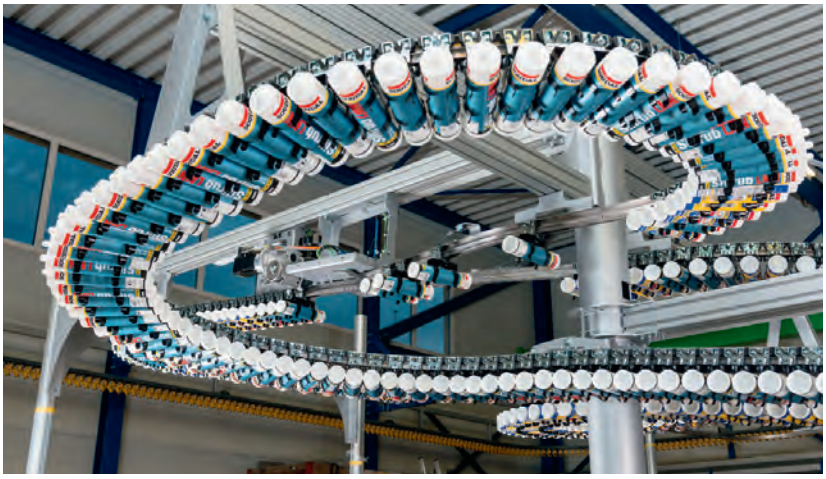
Conveying in the third dimension: RFID beats barcode

Barcodes are a cost-effective and versatile solution when goods need to be marked and unambiguously identified, but this optical detection method soon encounters its limits when the labels become dirty or damaged during the process and can then be hardly read, or not read at all.

Ferag AG, headquartered in Hinwil, Switzerland, has therefore opted to use RFID technology in the conveying technology that it has developed for various industrial applications and material distribution systems.

Its innovative conveying system, known as Skyfall, is a system that makes intelligent use of gravity and moves free-fall sections without its own drive. This saves energy and reduces the number of drives required. Thanks to a line layout with distance radii of 500 mm and generous tilt angles of up to 6° the system requires relatively little area, so there is also comparatively more room on the plant floor for free spaces and the filling and packaging equipment.



A recent example is a filling and packaging process for tubes of construction silicone, in which the system had to meets a special requirement of the user: eliminating the previous bottleneck between the filling station and batch packers. This is achieved because Skyfall not only handles transport of the cartridges, but also the accumulation buffer. "In this way," said Roberto Fenile, development manager at Ferag, "the differing speeds of the filling and packaging process can be compensated for and a consistently high system output is achieved. Compared with the previous approach, we have been able to double the production capacity."

The conveyor system has an output of 12,000 cartridges per hour, the heart of the overhead design being a rugged rail system with three-dimensional kinetics and roller bodies, called shuttles. These are loaded with the construction silicone cartridges which differ not only externally but also in their volumes. The empty cartridges are brought from a storage bunker to be filled at the end of the conveying and sorting process with specific amounts of construction silicone, then brought to a batch packer. Reliable identification of each individual shuttle is absolutely critical for the process, which is why Ferag decided on an RFID-based identification method.

"It even works reliably when the data carriers are contaminated by silicone residue," said Rolf Werner, Balluff sales engineer.

Ferag chose the BIS M industrial RFID solution from Balluff, which operates at a frequency of 13.56 MHz. "It not only meets the demanding requirements with respect to cycle rate and ruggedness, it can also work reliably in challenging metallic surroundings," Werner explained. Combined with passive data carriers, this HF solution offers average ranges of 20 mm. This makes BIS M suitable for parts tracking at close range or applications in production control or tracing for quality management. At Ferag, the system not only enables uninterrupted documentation of the processes but provides the data to the controller in real time and automates the complete material flow, including the filling and packaging process. The type and current location of each individual cartridge is known during the entire process. Data management is performed in the system's central computer.

Self-adhesive OnMetal RFID tags just 36 x 8 x 5 mm — similar to a part label — enable very flat identification of the shuttle. Since the data carriers bear a serial number fixed in memory (the so-called UID code), the shuttles can be identified unambiguously at any time. The data carriers conform to the international ISO standard 15693 and provide a general read distance of 10 mm, even on metallic substrates. This was one of the essential requirements of Ferag. Uninterrupted detection of the roller bodies is thus ensured over the entire material flow.

The UID is read by tubular M16 read/write heads from the Balluff RFID system, which are located at all the relevant locations along the transport path, such as at gates. The data carriers are passive, receiving the needed power from the read/write heads. This makes batteries unnecessary — the electronics and antenna are integrated into the tag.

"The size of the data carrier and the geometry of the read/write head play an important role," explained Willi Brändli of Balluff. "The HF field generated in the application must be large enough so that the tag dwells in the field long enough for us to read out the identity even at high speed. But at the same time, it needs to be small enough that there is no overlap with the following label during the detection process. This requires a lot of experience."

With the BIS V RFID controller an all-in-one unit is built into the system, which allows connection of up to four read/write heads. Combined with the read heads, it offers the required high-read speed. Due to the four ports the number of controllers required is reduced, saving Ferag considerable expense. If necessary, read heads using different technologies (LF, HF and UHF) can be connected.

A longer and more detailed version of this article can be read online at: http:/bit.ly/2qCWthg

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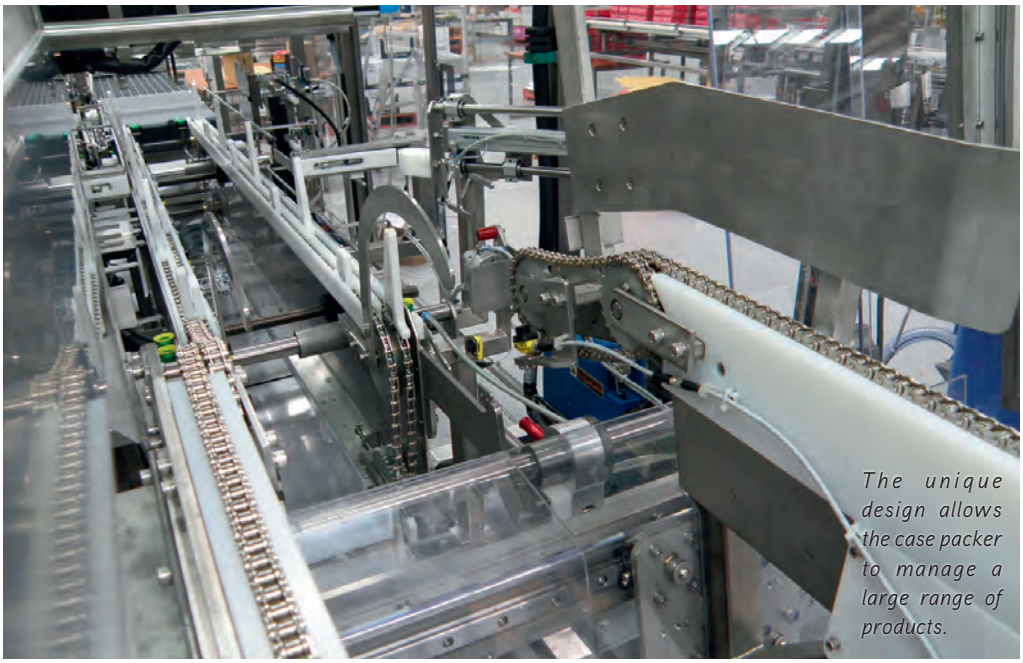
Having all the products on the supermarket shelf neatly packed with labels facing forward used to be a labour-intensive task, but now, thanks to advances in technology, bottles can be positioned into cartons, forward facing, as a fully automated process.

A global food manufacturer asked Hot Melt Packaging Systems (HMPS) to provide such an end-of-line solution for its high-speed condiment production line.

To meet growing demand, the manufacturer had previously upgraded its main condiment production line to produce twice as much product in half the time. Bottles are sterilised, filled, capped and labels applied. The production line produces different sized and shaped bottles ranging from 500 mL to 4 L. To accommodate this, there is a multiple range of case sizes, pack configurations and bottle shapes.



The unique design allows the case packer to manage a large range of products.

According to Warren Booker, NSW state manager at HMPS, "In Australia, manufacturers are challenged by having to produce so many different products in the one machine. In countries with larger populations, like the US and Europe, one machine can be dedicated to a specific product, which makes the machine design more simplistic. The Australian market has a unique requirement where they need a machine to be flexible to grow with the business and pack a range of different products in different packing arrangements."

HMPS worked closely with the customer to design a fully automated system that meets all the requirements for this application today but also has the flexibility to meet future demands.

The challenge ahead was to pack bottles that are coming off the production line at 100 bottles/min into a six by three pack configuration with labels forward facing. "There were fundamental considerations that required attention in the design phase to achieve this with a key focus on detailed simulation to make sure the advanced level of motion control required could be achieved," explained Booker.

Given the large range of products being produced and the need for shelf-ready cartons, this production line had clear and precise requirements which HMPS had to comply with. Using the latest technology and working closely with the customer-specified needs has allowed this project to be a smooth transition into full production speed maintaining high efficiency and reliability.

Having worked on previous projects with Rockwell Automation, HMPS knew that the Integrated Architecture system would provide the best solution for this application. Allen-Bradley CompactLogix uses a common control engine and integrates safety, motion, discrete and drive capabilities in the case packer system.

Advanced motion control is provided by Allen-Bradley Kinetix 5500 Servo Drives and PowerFlex variable speed drives. Given the high-speed packing requirements of the system, safety door switches and guarding was provided by Allen-Bradley industrial components. In addition, the case packer system has integrated control, drives and safety capabilities via Ethernet using Stratix 5700 Ethernet switches. PanelView Plus 7 provides high-quality HMI for the system.

"To futureproof the machine, a degree of adjustment in the machine had to be considered. Due to the need for relatively quick changes, we have supplied a fully automated system," commented Booker.

All the SKUs or product range are listed on the main screen so the operator can go to see the core product and the machine will automatically resize at a touch of a button. In this way, the machine can apply the resize down to just using the one operator. In addition, the machine won't run until everything is in exactly the right position and all guards and doors are in the safe (closed) position.

"We have a modem in the machine that looks at running time and reliability factor. In this way we have a track record of parameters as part of the control system, how it's been running, how long etc. We have the software which allows us to log in remotely," added Booker.

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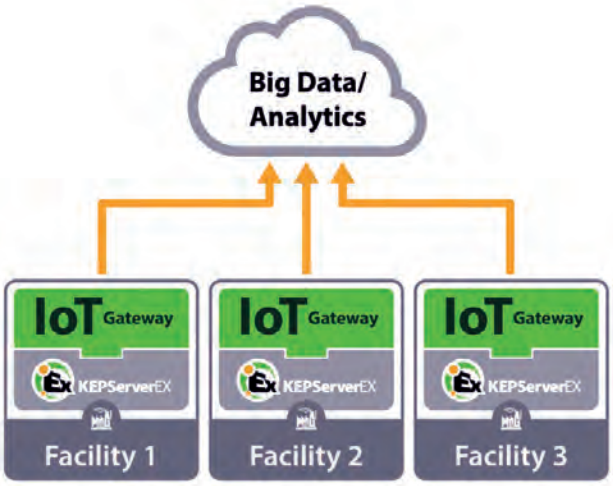

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THE MAINTENANCE OF THINGS

ASSET MANAGEMENT AND THE IIoT

Glenn Johnson, Editor

The so-called fourth industrial revolution is promising enormous advantages in plant and asset reliability and uptime by making it possible to predict the future condition of assets before they fail.

The transition from preventive maintenance to predictive maintenance will be enabled by increased amounts of data that is more accurate and that can be analysed to produce reliability predictions — avoiding unscheduled downtime and therefore improving the business bottom line.

The impact of the Industrial Internet of Things (IIoT) will be to help:

- enhance asset performance
- lower maintenance costs
- improve asset reliability
- enrich business performance.

The IIoT, utilising collaboration with big data and cloud capabilities, will have a significant impact on asset management. It will become possible to gain insights into the real-time health of physical assets. IIoT provides enhanced connectivity within the plant, with more smartly connected devices, while ensuring a cheaper, less time-consuming and smoother data gathering process.

IIoT concepts

The intention of the IIoT concept is to collect data from devices in the plant or in the field and then processes the data using sophisticated analytic software systems. Doing so is intended to enhance business processes and create operational improvements that were previously unavailable. However, achieving the transformational potential of the IIoT is not as simple as deploying so-called 'smart' plant technology. Getting significant benefits from the IIoT requires a collection of software, hardware, communications and networking technologies, all working together in a way that is optimised to the needs of the business.

The IIoT concept is based around the more loosely defined Internet of Things (IoT) that is making itself known in the wider non-industrial world. For industrial organisations, there is some advantage already inherent in the nature of the wired and networked automation technology that is already found in process plants and factories. Industry already has standards for the

interconnectivity of smart devices: the question is whether those standards, and the current implementation of connectivity in our plants, can support the extra data connectivity and processing that is necessary to take advantage of the IIoT.

Currently the wider Internet of Things is in an emerging state, with no widely agreed-upon standard for systems, networks or interfaces. Multiple communications technologies are used and a variety of embedded intelligence technologies, as well as sensor and actuator solutions, are available, and there are as yet no agreed-upon standards of interoperability that take into account the higher-level applications that the IoT concept seeks to achieve. And in the industrial world, the IIoT has a unique set of requirements relating to operational, safety, security and regulatory issues that don't necessarily apply in the wider commercial world.

Components of the Industrial IoT

The IIoT depends on four aspects or parts:

- So-called 'smart' assets
- Suitable data communications infrastructure
- Analytic systems and applications
- Interpretation of the data.

Smart assets can include instrumentation and sensors, equipment, machines, systems or other assets that include their own processors, memory and communications capabilities. Such assets will generate more data and some (such as robots) will eventually operate autonomously.

Data communications between assets and other entities will often leverage wireless network technologies such as IEEE 802.15.4 or Wi-Fi, in addition to industrial Ethernet and (to some extent) wired fieldbus technologies.

The additional data provided by smart assets requires that powerful new analytics applications be developed to take advantage of it. Information generated by these applications (hosted locally or more likely using a cloud infrastructure) will lead to new business models and better optimisation of assets and processes.

By having access to more and better data, organisations will increasingly make decisions based on the analysis generated by these resources. People will also continue to become better connected to others and to plant equipment, machines and systems through social and mobile tools and applications.

Asset maintenance models

Similar to the IoT, there are no generally agreed-upon models for the best asset maintenance strategy or methodology. Research by ARC has shown that there are many different versions of maintenance strategy models. Industry lacks a true standard to build upon, making it difficult to compare solutions — leading to confusion and delaying the application of solutions. A clearer interpretation of terms such as 'condition-based', 'predictive' and 'prescriptive' maintenance is needed to be able to clearly define where the IIoT comes into play.

The ARC Advisory Group has published an asset-management maturity model[1] in which the impact of the IIoT has been taken into account to classify maintenance maturity into five types or levels, as shown in Table 1: reactive, preventive, condition-based, predictive and prescriptive.

Obviously reactive maintenance is an undesirable approach, unless the asset really is not consequential in any way for the business and its failure will not have significant impact.

Preventive maintenance is the more commonly found cyclic system of working that has been in place in process plants and factories for many years: lubrication of moving parts and battery replacements are simple examples, but this applies to any asset that requires regular testing, checking, calibration and potential part replacement on a semiregular basis (eg, safety valves, pumps and instruments).

In recent years, many organisations have tried to move toward a more condition-based (CBM) approach to minimise downtime that results from performing maintenance where often it is not needed, thereby reducing downtime cost and business impact. To do this requires the monitoring of a specific parameter (such as pump vibration or valve stiction) and collecting the data over time to establish a trend, making it possible to optimise the maintenance intervals for specific types of equipment. For static equipment such as tanks, boilers and piping, this is usually a regular manual inspection. Some equipment and software vendors have released systems specifically for logging and automating these tasks and providing predictive reporting or alarms.

Predictive maintenance can be seen as a more advanced extension of CBM, in which multiple variables and advanced computer analysis provides higher accuracy and more advanced warning to prevent failure. Advanced predictive maintenance analysis systems emerging today utilise a 'digital twin' model of assets and systems to compare measured and trending values with model-idealised values. Prescriptive maintenance takes this a step further with deeper diagnostics and guidance on repair and urgency.

Predictive and prescriptive maintenance are the areas where the benefits of the IIoT concept will be of most advantage.

Benefits

While predictive and prescriptive maintenance will require more engineering investment to achieve, they have the potential to create economies of scale that result in extensive business savings. That is, once particular devices and systems are modelled, and if those devices or systems are in extensive use, then the models apply to all instances in the form of a template.

Various claims have been made about the effect of organisations moving from preventive to predictive maintenance: some reporting up to 50% savings in maintenance labour and materials, and some claiming it is possible to achieve nearly zero unplanned downtime. Such savings have a flow-on effect in the business to better production, greater safety and greater customer satisfaction through on-time delivery.

How the IIoT can impact asset reliability

The key to the benefits of the IIoT are contained in one word: information. With an increasing use of networked devices, more asset information becomes available. If the information is structured in the right way, the information coming from a particular machine or class of assets, along with other process or environmental information, can be combined with advanced analytics to offer new opportunities for improving asset reliability and uptime.

Greater information content means creating the potential to identify specific components and failure modes more in advance and more reliably, with fewer false alarms. Being able to identify a problem long before it can cause a major failure will have a significant impact on business performance.

Types of data

When we read about the IIoT and big data, we come across the concept of structured and unstructured data. To these we should add semi-structured data:

- **Structured data:** Data (usually numeric) that has a predefined structure or model and can be easily organised, understood and interpreted. Examples from OT would be historian data and the data stored in CMMS systems, while in the IT world, spreadsheets and relational databases are good examples.
- **Semi-structured data:** Sensor-based data that is yet to be organised in a useful form.
- **Unstructured data:** Data that is typically non-numeric and does not have a predefined model, such as images, video files, Word documents and PDFs.

Existing automation control systems work exclusively with strictly defined sets of structured data coming from field sensors and instruments, and process that data for the purpose of control of the process and real-time information for operators.

Increasingly, additional data is becoming available from technologies such as smart field instruments that record more than just, say, pressure or flow measurements, but also provide information about the accuracy and calibration of the instrument, or of process conditions that may affect their accuracy. Additional sensor technologies are being provided within machinery (such as smart bearings and braking systems) or being added as additional sensor elements (such as vibration sensors). The data becoming available from field and plant technologies is now growing far beyond the immediate real-time needs of the process control system itself. Smart industrial assets often include an embedded computer, typically with processor, memory, operating system and communications capability.

> PREDICTIVE AND PRESCRIPTIVE MAINTENANCE ARE THE AREAS WHERE THE BENEFITS OF THE IIoT CONCEPT WILL BE OF MOST ADVANTAGE.

Other types of sensing technologies can now also come into play: RFID technology in equipment, and in tools being carried by technicians, as well as wearable technologies that enhance worker safety or provide health and security functions by tracking worker location and exposure to hazards.

Some of the unstructured data mentioned above would come to the fore when creating a prescriptive maintenance system. Documents in formats such as PDF and Word (like operator manuals and specification documents) contain information necessary to prescribe setting and behaviours around the plant's various technologies. Such information needs to be both accessible in real time for the technician in the field and also available to an expert software system that can use it to assist with maintenance modelling.

The resulting myriads of new structured, semi-structured and unstructured data are of no use without the networking, processing and analytics technologies to take advantage of them.

Horizontal and vertical communication

In the traditional communication process control system, data is exchanged 'horizontally' between controllers and field devices. However, IIoT integration means moving larger amounts of data in a 'vertical' fashion — that is, up through the data networking hierarchy to the business systems and the internet.

The trick here is to collect the extra data for vertical integration without impacting the horizontal operational activities and by not introducing cybersecurity risk issues though the process of IT/OT integration at the higher networking levels. The large quantities of additional data, from many devices, needs to be aggregated in some way and pre-filtered.

Different approaches to this problem have been offered in the marketplace, and the best solution may depend on the requirements of the plant. For example, some vendors propose a gateway solution in which the non-process control data is forwarded to a gateway for initial processing and aggregation before being forwarded 'upstream' — one advantage of this solution is that there need only be gateway devices communicating outside the control network, making cybersecurity more manageable. Another method is the use of more powerful and advanced controllers (PACs rather than PLCs) that perform both process control and IIoT data processing. However, if the only way to collect additional data in a brownfield site is to add extra sensing devices via a wireless infrastructure, then it will more likely be on a separate network in any case.

Whatever the method chosen, serious consideration must be given to all aspects of the network infrastructure that will support vertical integration.

Big data analysis provides more intelligence

Smart devices and improved connectivity lead to the generation of much larger amounts of data. As more things become smart and connected, the volume and variety of data that must be collected, managed, stored and analysed will only increase.

Approach	Method and application
Reactive	Run to failure, and then repair. Applied when failure is unlikely, easily fixed or the system is non-critical.
Preventive	Service in a fixed time or cyclic interval. Used when the probability of failure of an asset increases with use over time.
Condition-based	Based on trending data collected over time, usually from a single variable. Used for assets with more unpredictable likelihood of failure. Data may be collected manually or automatically.
Predictive	Data collected from assets is analysed using algorithms or machine learning, along with digital models of equipment or 'digital twins'. Used when assets are critical and unplanned downtime will have significant impact.
Prescriptive	Similar to the predictive method, but with the addition of prescriptive knowledge and information such as guidance on repair. Useful for complex systems with multiple variables to be analysed, and requiring complex skills to diagnose.

Table 1: Asset maintenance models.

To gain benefit from big data, organisations will have to take full advantage of the advanced analytics solutions that are now becoming available. These analysis applications need to be able to bring useful, actionable information to the right people, applications and systems in an appropriate time frame and context, so that industrial organisations can optimise.

The main purposes of such data analysis are firstly to provide feedback for humans to interpret and act upon, and secondly to enable real-time logic to trigger the appropriate automated responses in mission-critical systems for routine processes.

In the early days of automation, reports simply indicated what happened, and it wasn't until the 1990s that multivariable systems were developed that provided insights into why something happened. In the early 2000s, more intuitive dashboards began providing performance data about what was happening in real time. Now, as a result of the integration of more advanced data analytics technologies from the IT world, along with the greater quantity of available data, we are seeing a trend towards predictive analytics, offering the potential to predict the future to enable appropriate actions to optimise plant and business performance.

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1. Rio R 2017, 'How an IIoT-enabled maintenance maturity model works', Plant Engineering, ‹http://www.plantengineering.com/single-article/how-an-iiot-enabled-maintenance-maturity-model-works/f2ecbee2bcfac8a5dd7b2bb9d7f056a8.html›

Good teamwork: getting a safe hand from robots

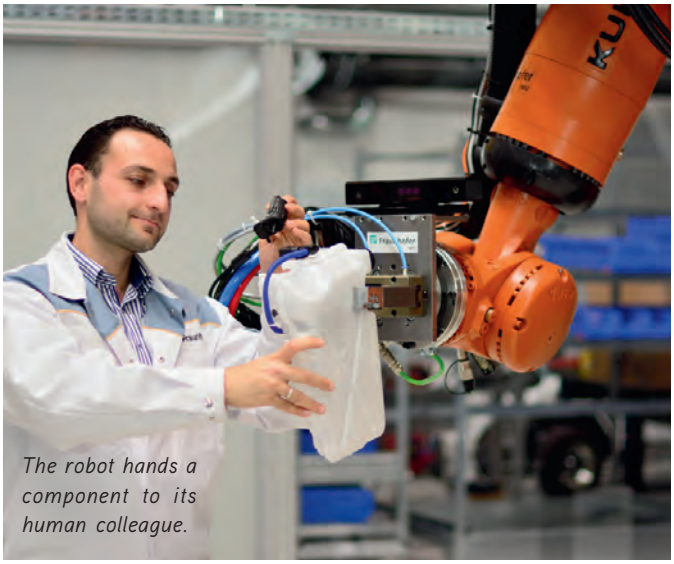
Heavy-duty robots in manufacturing, which can easily lift components weighing 200 kg, swivel around quickly or move with a speed of up to two metres per second, pose a danger to human lives. To rule out any potential risk to employees, these steel colleagues have so far operated in a separate environment. However, cooperation would be much more efficient if humans and robots worked side by side, without protective barriers. But how does one ensure safety? The Fraunhofer Institute for Machine Tools and Forming Technology IWU has come up with a solution to this problem.

The experts at Fraunhofer IWU have developed a differentiated safety concept that begins by defining different levels of collaboration. The more intensive the interaction between human and machine, the higher the level and more stringent the safety regulations. For example, if the robot needs to hand over a component to an employee, it moves as slowly and carefully as determined for this level. When working on separate tasks at a safe distance from each other, robots can work at full speed. Fraunhofer researchers have defined a total of four levels of collaboration.

These levels are supplemented by dividing collaborative work areas into spatial zones. Each zone specifies how close humans and machines are to each other. At the lowest level, there are only two zones: a green and a red zone. If the employee is at a safe distance from the robot, it indicates a green zone and the robot can work at full speed. As soon as an employee approaches, a red zone is activated and the robot immediately stops working. In instances where teamwork is required — for instance to swap components or tools — then a yellow zone of cooperation is added. The heavy-duty robot now moves carefully and at low speed.

In order for the robot to respond properly, it must know the employee's position and route at all times. It can do this with the help of several cameras that enable it to 'see'. Two cameras are placed above the work area and provide a view of the entire work space. They also show the employee's current location. An additional camera sits on the 'head' of the robot and captures the close-up area. It helps the robot recognise the face, hand or component in the employee's hand.

A row of sensors supplements the cameras. To prevent a collision, they register parameters such as the robot's position, acceleration and power as well as the employee's position and movement. The intelligent algorithms developed by Fraunhofer IWU help evaluate all this data. They ensure that the robot's behaviour is constantly aligned with all the safety regulations based on the task and situation at hand.



The robot hands a component to its human colleague.

© Photo Fraunhofer IWU.

"Our system is already fully functional and has been tested in the lab. This year, the goal is get the trade association to test an application and enable its implementation in the industry," said Professor Matthias Putz, Director of Fraunhofer IWU.

This technology has already been tested in virtual reality. Using VR goggles, users can virtually experience teamwork with the machine. The system runs at full speed in virtual reality mode. "VR technology is thus an excellent way to realistically test the interaction with a robot," said Professor Putz. Fraunhofer experts want to refine the system in the near future. "Soon it should be able to adjust to the employee's behaviour by analysing the person's movements," Putz explained. "In addition, we are working on gesture recognition, which will enable an employee to control the steel colleague with hand movements. For example, using a hand gesture to ask the robot for a tool."

Fraunhofer Institute for Machine Tools and Forming Technology IWU
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- **Where:** International Convention Centre Sydney, Darling Harbour

SYDNEY WELCOMES FOODPRO 2017

Registration is open for foodpro 2017 — the iconic event for the food and beverage manufacturing industry.

This year's event sees foodpro celebrate 50 years supporting Australia's food industry and showcasing the latest technology and innovations in food processing, packaging, science and technology.

The event provides a platform for food industry professionals to meet face to face with suppliers of cutting-edge processing, packaging and plant technology, as well as the latest in food science.

foodpro is organised into six zones, each dedicated to the various steps in the food manufacturing process: Ingredients, Food Science and Technology, Processing Equipment, Plant Equipment, Packaging and the new Supply Chain Integrity Zone.

The Supply Chain Integrity Zone is an initiative brought about by a partnership between foodpro and Food Innovation Australia Ltd (FIAL), and is aimed at the needs of small manufacturers. In particular, supply chain security is vital to the food manufacturing process, with traceability and audit compliance a priority; however, smaller manufacturers often find it costly to comply. The majority of technologies for traceability are often geared to larger manufacturers, which causes obstacles and barriers for smaller players in the industry.

The Supply Chain Integrity Zone is focused on solutions for small manufacturers who produce pre-packaged goods for sale to the consumer. Companies across the various stages of the supply chain will be represented, allowing visitors to discuss end-to-end solutions with suppliers best suited to their business. The zone will also include a series of seminars covering the latest technology, capabilities and insights.

"The Supply Chain Integrity Zone is a really important and exciting addition to foodpro," said Peter Petherick, foodpro event director. "foodpro has supported Australia's manufacturing needs for 50 years, and it's important we continue to respond to the industry as it changes. It's become clear that there is an increasing number of smaller manufacturers whose needs, although similar to the bigger companies, must be met in more specific ways. The new zone serves a purpose for solutions and, importantly, for discussion and engagement. With a focus on improving traceability and supporting audit compliance, the benefit to the industry will be incredible."

The zone will feature companies that offer solutions specifically for smaller manufacturers who produce less than 10,000 units a week, with a focus on areas including materials in, processing integrity, packaging integrity, shipping and receivables, and quality management solutions for traceability.

Visitors will have the opportunity to meet Australian and international specialist food manufacturing suppliers to find out how they can increase production efficiencies, cut costs and stay ahead of the competition. They can also hear from expert speakers on the latest trends in the industry, such as traceability, food safety and hygiene, in a series of free seminars.

foodpro is co-located with the Annual Convention of the Australian Institute of Food Science and Technology, where the latest thinking in food technology and processing will be discussed. It will be held at Sydney's new International Convention Centre (ICC), Darling Harbour, from 16–19 July 2017.

Visitors should be aware that ICC Sydney's exhibition space is split over two floors. Level 1 (Lower Exhibition Hall) will include these zones:

- Plant Equipment and Logistics
- Food Science and Technology
- Ingredients
- Supply Chain Integrity Zone
- Central bar

Level 4 (Upper Exhibition Hall) includes these zones:

- Processing and Packaging Equipment and Technology
- Cafe
- Visitor registration

Seminars will be held on Level 3 and the entry hall is on Level 2. For more information, visit foodproexh.com/floorplan.

foodpro is strictly a trade-only event. For more information, visit http://www.foodproexh.com.

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EMBEDDED PC

Interworld Electronics has released the ACS-2330 multicore embedded box PC from Aplex Technology. The ACS-2330 is a high-performance standalone embedded PC featuring fanless operation, compact size and robust construction.

The ACS-2330 is based on the Intel H170 chipset and can be purchased with a 6th generation Intel Core i5-6500TE 2.3 GHz or i7-6700TE 2.4 GHz processor. It is equipped with two SODIMM sockets supporting up to 32 GB of DDR4 system memory, four Gigabit RJ-45 Ethernet connectors, four USB 3.0 ports, two USB 2.0 ports, four digital inputs, four digital outputs, two RS-232 ports and two RS-232/422/485 ports for communication. Two easily accessible 2.5″ SATA hard drives can be internally mounted for operating system and data storage.

System expansion is possible via three Mini-PCIe Card slots. One Mini-PCIe slot can be used for mSATA SSD storage. The onboard Intel HD graphics engine provides a DisplayPort, DVI-D and HDMI output for high-resolution displays.

The unique heatsink and fanless design of the ACS-2330 ensures long-term reliable operation in industrial and embedded environments. The ACS-2330 require a 9–36 VDC power source for normal operation. An optional 100–240 VAC power pack is also available.

Interworld Electronics and Computer Industries

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FANLESS COMPUTERS

The POC-300 Series from Neousys Technology is a fanless PC controller with ultracompact dimensions (149 x 105 x 57 mm) — a footprint similar in size to a 3.5″ hard disk drive. Powered by the Intel Apollo Lake Pentium N4200 and Atom E3950, the POC-300 is capable of supporting a maximum of 8 GB memory to meet the demands of high-performance applications. The isolated I/O provides users with connectivity for digital devices, while the considered interior design minimises compatibility and cabling issues.

The POC-300 supports a number of I/O interfaces, including four COM ports, four USB ports, four isolated digital I/Os, two PoE Gigabit Ethernet ports, a standard Gigabit Ethernet port and an mSATA port. The POC-300 also provides one Mini-PCIe slot with one USIM socket for wireless requirements. It also supports Neousys's MezIO Module System, allowing users to add many expandable modules to the system; these include extra COM ports or an additional PCIe socket.

A performance-enhancing mechanical and thermal design improves the heat dissipation more efficiently by utilising an aluminium alloy chassis. Supporting industrial SSD storage, the POC-300 meets an extended operating temperature range of -25 to +70°C suitable for harsh environments.

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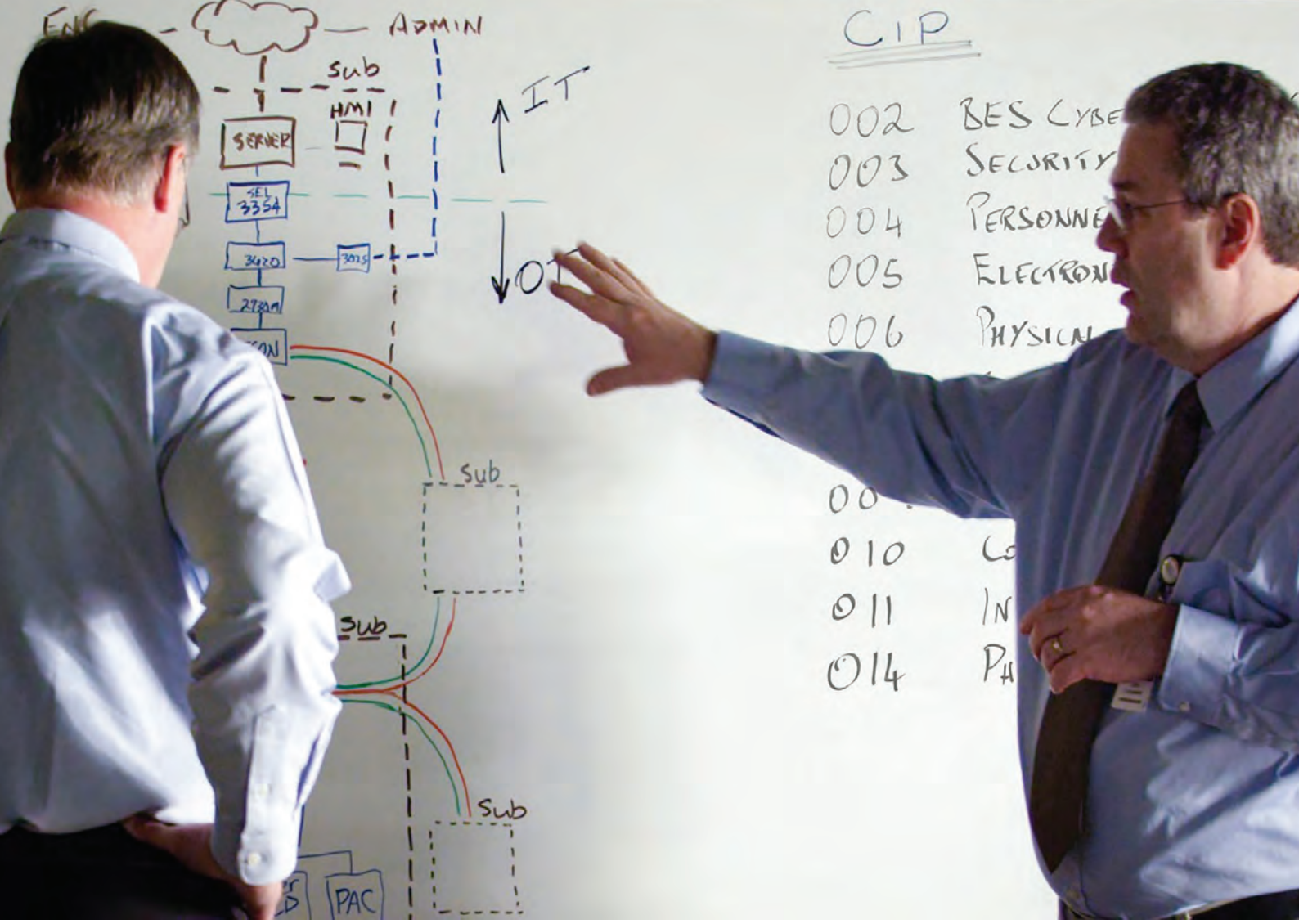

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The ISOLine range introduces the IMI Norgren Adaptive Cushioning System (ACS). ACS automatically adjusts the cylinder cushioning for changing loads, so a manual cushion screw setting is not required. It also removes the need for specialist knowledge and simplifies the installation process for safe, smooth operation.

Conforming to ISO standard 15552, the product range is up to 20% lighter than previous pneumatic cylinders. It is said to provide improved performance, with low breakaway pressure and reduced minimum speed. Available in sizes 32–125 mm, the streamlined design of the product offers a modern look with a clean profile. For system designers, additional switch mounting gives greater design flexibility.

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CLAMP METER WITH BLUETOOTH

The Hioki CM3286-01 Cat IV (600 V) is an auto-ranging, Bluetooth-compatible clamp tester that measures leakage current and mains current to 600 A, voltage to 600 V, single- and three-phase balanced power, energy, reactive power, power factor, phase angle, frequency and total harmonic distortion for current and voltage.

Power can be measured form 5 W to 360 kW (single-phase), 20 W to 623.5 kW (balanced three-phase/3-wire), and 40 W to 1080 kW (balanced three-phase/4-wire).

The product is IP54 rated, and clamps up to 46 mm-diameter conductors. A dedicated app to acquire measurement data on a smartphone or tablet is available, allowing reports to be automatically created from measurement data in the field. Supported devices include Android SMART model, iPhone 5, third-generation iPad and iPad mini.

Power Parameters Pty Ltd
www.parameters.com.au

INTELLIGENT SYSTEMS

Advantech has announced a full range of platforms based on 7th generation Intel Core processors, including industrial motherboards, slot single-board computers (SBCs), modular IPCs, industrial server-grade motherboards and transportation platforms. With a high-performance CPU for media, graphics and security, these platforms are suitable for powering intelligent systems designed for diverse markets, such as video surveillance, medical, industrial automation and transportation infrastructure. Advantech has designed these products in accordance with the Intel Intelligent Systems Framework.

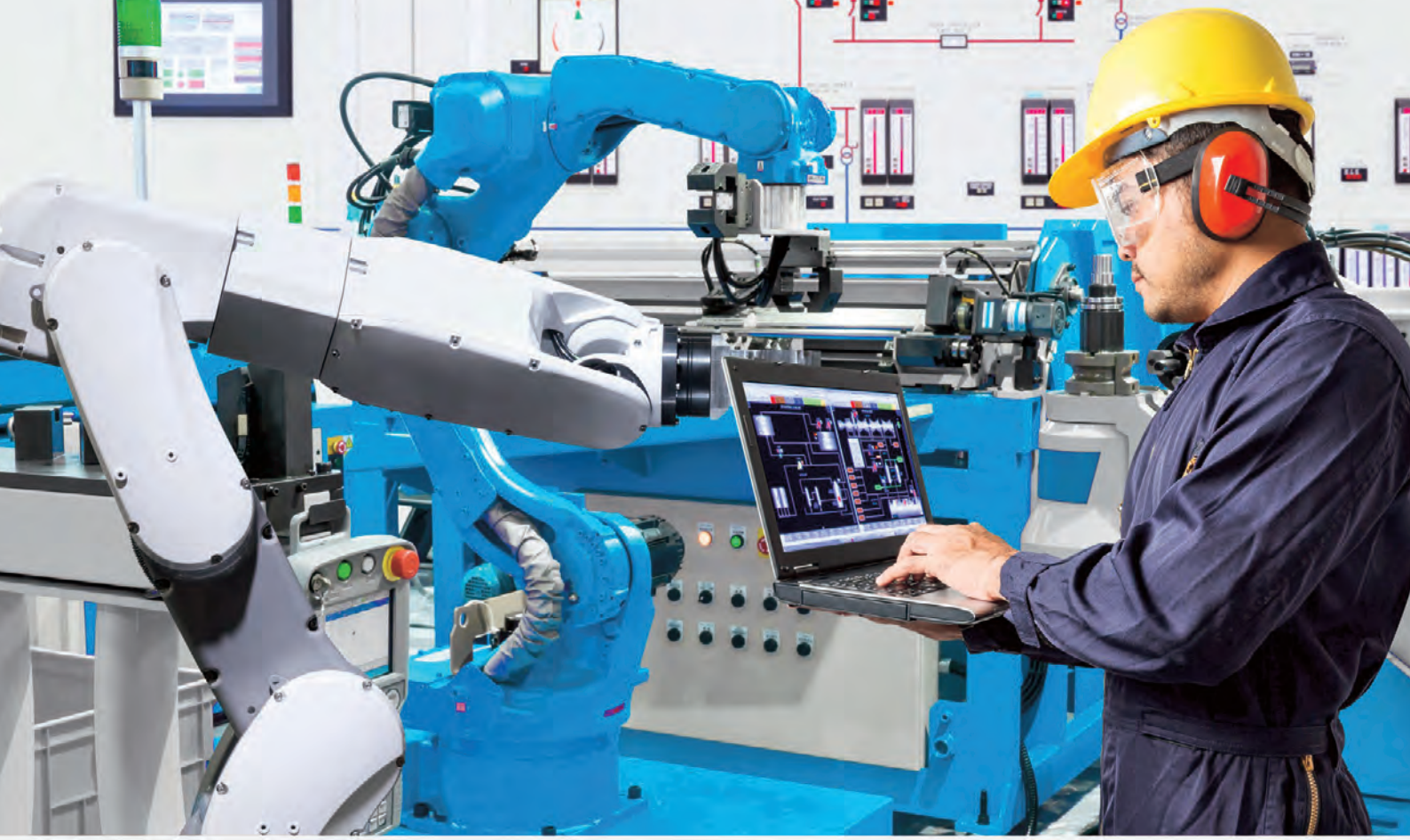
Of the product lines using 7th generation Intel Core i7/i5 processors, the PCE-5129, PCE-5029, PCE-7129, PCE-3029 and PCE-4129 represent the industrial-grade PICMG 1.3 SBC line, and AIMB-785 and AIMB-705 fill the ATX form factor line.

In the modular IPC product line, MIC-7700, AIIS-3400 and AIIS-3410 focus on the machine automation market. In the transportation field, ITA-5231 and ITA-5831 products enhance the performance of passenger information systems, media broadcasting and in-train surveillance.

ASMB-585 and ASMB-785 server-grade motherboards come equipped with an upgraded processor and DDR4 memory support, and can deliver increased computing efficiency for applications with high-performance computing requirements.

These intelligent system products are equipped with multiple OS options, Advantech SUSI Access and WISE-Cloud.

Advantech Australia Pty Ltd
www.advantech.net.au



Sensors for Predictive Maintenance

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PROTECTING OPERATIONS IN THE ENERGY SECTOR AGAINST CYBER ATTACKS

The development of the digital oilfield promises new and more efficient ways of doing business for oil and gas companies, but at the same time exposes them to serious risk of cyber attack.

Driven by rising costs in exploration and production as well as by increasing competitive intensity and regulatory pressures, oil and gas companies are looking for new ways to increase production capacity and operational efficiencies. This has led to the rapid adoption of digital technologies to help run their organisations.

As these technologies are implemented across oil and gas operations, they are creating what is now called the digital oilfield. It is the result of a convergence between IT and operational technology (OT), and represents a new way of doing business that is helping oil and gas companies reduce operational costs, improve efficiency and production, and comply with regulations.

At the same time, this transition to the digital oilfield is exposing companies to serious risks from cyber attacks, putting worker safety, production, reputation and, ultimately, profits at risk. Today, more than ever before, a successful attack can lead to devastating consequences for infrastructure, intellectual property and corporate profitability.

The energy sector's vulnerability to cybercrime

Security threats are expected to grow in the future. In the past four years alone, the financial impact of cybercrime has increased by nearly 78% and the time it takes to resolve a cyber attack has more than doubled. Across all industries and geographies, it has been estimated that cybercrime costs some US$400 billion in lost time and assets.[1]

The oil and gas industry is certainly not immune to this threat. In fact, research shows the energy industry is unusually highly targeted. In 2014, the energy industry topped the list of all Australian private sector industries requiring the assistance of CERT Australia in relation to cybersecurity incidents, ahead of banking and finance, and even the defence industries.[2] According to IDC Energy Insights, security concerns are already ranked number nine among its "top 10 [global] oil and gas industry issues" in 2012.[3]

And the costs are high and rising. The average annual cost of cybercrime incurred by a benchmark sample of 30 organisations in Australia was AU$4.3 million, representing a 33% increase from when the study was conducted three years earlier.[4] Moreover, an ABI Research study predicted that globally, cyber attacks against oil and gas infrastructure will cost companies US$1.87 billion by 2018.[5] Oil and gas companies are high-risk targets for many reasons. Malicious actors seek to accomplish political or economic goals. Disgruntled employees want revenge. Others want financial gain or access to valuable proprietary data on reserves and discoveries. Whatever the motivation, high

downtime costs and attack frequency rates necessitate strong cybersecurity protocols.

Migrating to the digital oilfield

The digital oilfield fuses two different technologies together using open IT protocols: operational technology (OT) with supervisory control and data acquisition (SCADA) and back office enterprise IT systems.

As a result, companies are realising vast gains from insights and actions as data is integrated and analysed in real time. For example, digital oilfield instrumentation is enabling horizontal drilling and multilateral wells. Sensors allow superior surveillance of pipelines. And real-time visibility into operations allows companies to better control costs and optimise the performance of employees, assets and facilities.

Modern two-way radio technologies are IP based and are enabling greater workforce efficiency and safer work practices by offering integrated field voice and data communication services. Advanced radio systems such as P25 and TETRA can be integrated with SCADA and back office IT systems to promote efficient work processes and enhanced management of critical assets.

But the combination of open standard-based IP protocols and integration into back office systems also puts companies at considerable risk of cyber attack.

Cyber threats are growing in new ways and places

The convergence of SCADA and IT environments is not the only security issue causing concern. Successful attacks in the form of viruses and worms have demonstrated that companies often underestimate the vulnerability of diverse systems.

Newer technologies such as those controlling drilling rigs and cloud-based services are subject to probes or attacks. So too are once-isolated plant control systems that are now integrated with corporate networks or vendors. Even private smartphones and devices used by company employees potentially open up a network to an increasing number of threats and malicious behaviour. It is estimated that 96% of such mobile devices do not utilise encryption protection.[6] Such threats can target data at rest on the device and can be introduced through online web surfing.

In short, wherever there is digitally enabled technology or an intelligent device, even a simple device that controls a valve on the pipeline, there is a risk of it being used as a portal and taken over without authorisation. Cybercriminals are targeting the entire spectrum of potentially valuable data: data at rest, data in transit and data in use.

While IT and OT share many similarities, it is important to highlight some unique characteristics of OT systems. OT comprises SCADA systems that monitor and control critical infrastructure — threats to which, if realised, have real consequences such as personal injury, catastrophic equipment damage, lost production capacity, environmental impact or violation of legal and regulatory requirements.

Threats against IT and SCADA systems

Threats against IT and SCADA systems can come from a wide range of sources, some of which are adversarial such as hostile governments, while others arise from natural sources such as human errors and accidents. Data breaches committed by these sources can come from a variety of threat actions, some of which are discussed below.

Malware

Malware is any malicious software that has been developed for the purpose of compromising or harming information assets without the owner's consent. Cybercriminals often target IT data assets such as those stored on servers, data sent by emails and stored on mobile devices and even information backed up on USB memory sticks. Even two-way radio systems that are considered 'isolated' from the enterprise IT network are vulnerable to malware attacks. If a competitor steals blueprints to a company's power grid or key pipelines, it could disable operations and cause serious economic damage.

Watering holes

Instead of directly inviting users to visit a website, this attack gathers information on targeted users and compromises a legitimate

> COMPANIES ARE REALISING VAST GAINS AS DATA IS INTEGRATED AND ANALYSED IN REAL TIME.

website they are likely to visit. Malicious software covertly added to the site then infects the viewers' computers. By taking advantage of the user's trust in a website, the watering-hole technique is an effective method and its use against Australian networks continues to grow. In fact, in October 2014, CERT Australia issued an advisory warning of watering-hole activity specifically targeting organisations in the energy sector.[7]

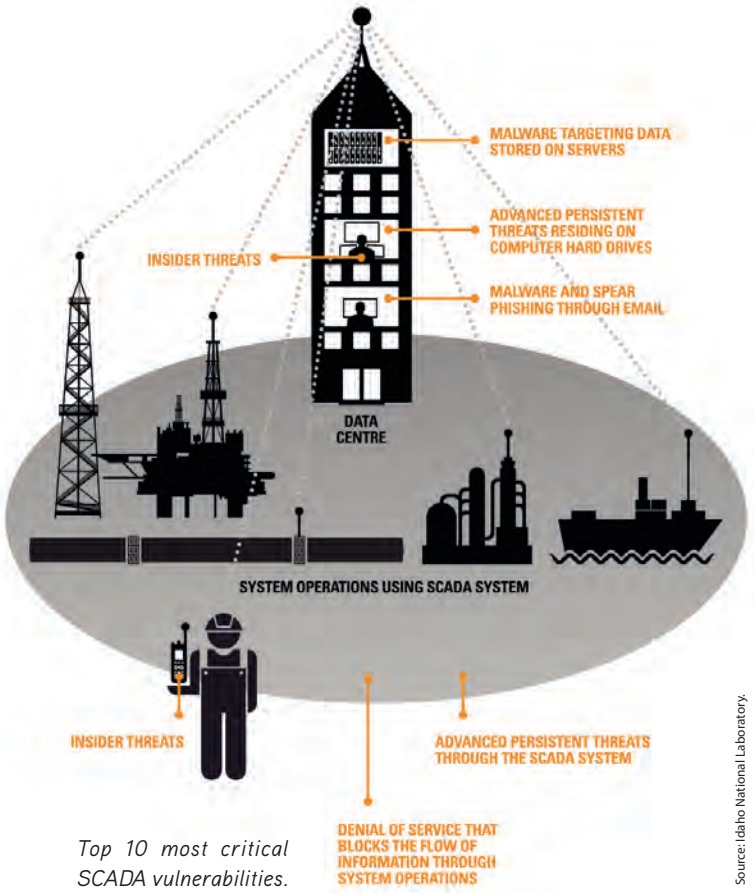
Spear phishing

Humans are notoriously susceptible to social tactics such as deception, manipulation and intimidation. A spear phishing attack exploits this weak point by using an email that appears to be from an individual or business known to the target. Data breaches based on social tactics have had a devastating impact on businesses, accounting for 37% of data stolen during cyber incidents in 2012.[8]

Advanced persistent threats

Advanced persistent threats (APTs) use targeted attacks as part of a longer-term campaign of espionage and sabotage, typically targeting high-value assets such as critical infrastructure. APTs are sophisticated and adapt to defenders' efforts to resist their attacks.

Oil and gas companies depend on the transmission of data to apprise management of new oil field discoveries, productivity levels and other mission-critical data. Imagine the damage that could be done if a competitor accesses an oil company's system and finds out where it has discovered vast oil or natural gas reserves.



Top 10 most critical SCADA vulnerabilities.

Source: Idaho National Laboratory.

Insider threats

A US Central Intelligence Agency analyst recently told an international group of government officials and engineers, as well as US security managers from electric, water, oil and gas and other critical industry asset owners, that "we have information, from multiple regions outside the United States, of cyber intrusions into utilities, followed by extortion demands. We suspect, but cannot confirm, that some of these attackers had the benefit of inside knowledge."[9]

This is not surprising. The Global Ponemon Institute report on cybersecurity found that the most costly cybercrimes are those caused by malicious insiders, denial of service (DoS) and web-based accounts. These account for 44% of all cybercrime costs per organisation on an annual basis.[10]

Denial of service

Oil and gas control system operation can be disrupted by delaying or blocking the flow of information through communication networks, thereby denying availability of networks to control system operators. This form of DoS can be caused by IT-resident services such as domain name system (DNS) — for example, using spoofed DNS requests. Clearly, where control systems are involved, DoS can have physical manifestations such as plant shutdowns.

These are just a few examples of how much can go wrong if an oil and gas company's systems are hacked or compromised. But there are solutions, providing security measures are tailored to meet the unique real and present dangers of individual companies.

The NIST framework

A 2013 study by the CSIS found that 96% of successful breaches could be avoided if the organisations put simple or intermediate controls in place.[11] In February 2013, The NIST Framework for Improving Critical Infrastructure Cybersecurity was created as the result of a US Executive Order, in response to the growing security, economy, public safety and health risks caused by cybersecurity threats.

The NIST Cybersecurity Framework provides a common mechanism on which organisations can:

- describe their current cybersecurity posture;
- describe their target state for cybersecurity;
- identify and prioritise opportunities for improvement;
- assess progress towards the target state;
- communicate among internal and external stakeholders about cybersecurity risk.

Cybersecurity involves much more than protection and prevention. It also involves the ability to quickly detect breaches and thoroughly research the extent and impact of those breaches.

New ways of doing business demands smarter cybersecurity

So what are the best practices to improve the security posture of the industrial control and IT systems supporting critical infrastructure?

What actions need to be taken to secure legacy systems? The cybersecurity strategy below is consistent with the NIST Framework and highlights a set of processes which, when executed concurrently and continuously, serve to improve an organisation's cybersecurity posture.

1. **Know your critical assets:** Identify your organisation's business objectives and high-value assets, then conduct risk assessments to find any vulnerabilities.
2. **Protect your IT, radio network and OT environments:** Establish defences to block intruders before they reach your critical business assets, and educate your employees to recognise and avoid cyber attacks such as spear phishing and watering holes.
3. **Detect potential threats before they occur:** Use the right tools to gain a comprehensive view of your security environment and monitor potential threats both externally and internally.
4. **Respond and recover:** With the speed and intelligence of many of today's cyber attacks, cyber breaches may still occur, even in the most secure infrastructure. Having a contingency plan in place can help you respond immediately if a breach should occur.

The digital oilfield brings huge advantages but also tremendous issues should a company's systems be hacked or compromised. However, there are solutions for protecting SCADA systems, mobile communication networks, smart sensors or other physical assets. Where oil and gas companies can stumble is when they fail to address vulnerable interfaces between their diverse systems or consider how their security infrastructure functions as a whole.

Best practices can improve the security posture of the OT and IT systems that make up the digital oilfield, greatly reducing the risk and potential cost of cyber attack. With the speed and intelligence of many of today's cyber attacks, breaches may still occur, even in the most secure infrastructure, but having a contingency plan in place can help ensure an immediate response if a breach should occur.

In short, the mantra for a healthy digital oilfield is to know your critical assets, protect the IT radio network and OT environments, detect potential threats before they occur and be able to quickly respond and recover.

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Motorola Solutions Australia Pty Ltd
www.motorolasolutions.com.au

NEW PRODUCTS

FLUID SENSORS

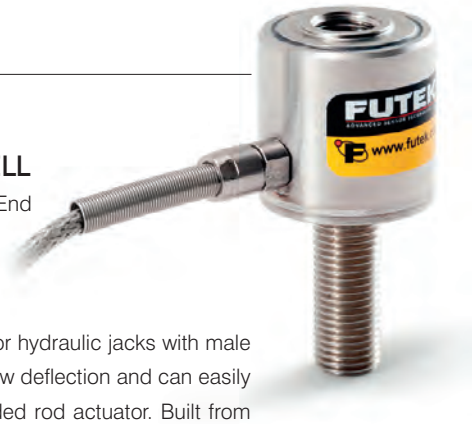
The Wenglor weFlux² is a high-performance, compact fluid sensor that measures flow velocity as well as temperature simultaneously in a single sensor, regardless of position and flow direction. The combination of the two functions reduces the number of measuring points in closed systems by 50% and minimises installation, service and inventory costs.

The maintenance-free sensors offer pressure resistance up to 100 bar. They can be installed in any position, allowing great flexibility in regard to the system layout.

Due to wTeach2 software, weFlux² sensors can be configured via the integrated IO-Link interface, without any IO-Link software tools or previous knowledge.

The sensors can be used wherever liquids are monitored, regulated and controlled. They are suitable for a wide range of industries including, but not limited to, the food, chemical, automotive and textiles industries.

Treotham Automation Pty Ltd
www.treotham.com.au



ROD-END LOAD CELL

The FUTEK LCB200 Rod End Load Cell (tension and compression) is designed for applications involving inline actuators or hydraulic jacks with male or female threads. It has low deflection and can easily thread in line into a threaded rod actuator. Built from robust 17-4PH stainless steel, it weighs approximately 99 g. The model is suitable for mid-range capacity requirements (453.6–1361 kg), offering high endurance.

The rod-end load cell has high stiffness, nonlinearity of ±0.5%, bridge resistance of 1000Ω and deflection of 0.001″ nominal. The cell can be modified or customised to meet customer requirements. It is available with an external matched output option, a fatigue rating and a Teflon cable.

Metromatics Pty Ltd
www.metromatics.com.au

ULTRASONIC SENSOR

Banner Engineering has introduced its Sure Cross U-GAGE K50U ultrasonic sensor for use in wireless tank monitoring applications. Optimised for use with Banner's Q45U Wireless Node, the pair provide a plug-and-play solution to monitor levels in mobile or remotely located tanks and totes.

The K50U detects distance from target to sensor in ranges between 300 mm and 3 m, and features built-in temperature compensation for accurate measurements. The sensor features a standard 1¼″ NPT connection and can be combined with the optional BWA-BK-006 bracket and Q45U Wireless Node (sold separately) for an easy-to-mount, IEC IP67, NEMA 6P level monitoring solution.

The sensor is also a suitable solution for a range of applications beyond liquid or chemical tank level monitoring, such as pallet presence sensing or monitoring dry material level in a hopper. The K50U is available in two models, with a 1-wire serial interface or a model that functions as a Modbus slave via RS485. Compatible with a wide range of Banner Engineering wireless nodes, the K50U provides reliable sensing for a single sensor application or integrated as part of a multiple sensor, long-distance multihop network.

Turck Australia Pty Ltd
www.turck.com.au

EARTH RESISTANCE TESTERS

The Hioki FT6380 and Hioki FT6381 are precision earth resistance measurement clamp-on testers. Precise voltage is injected and, by means of current measurement, earth resistance is computed and displayed. The Hioki FT6381 is the Bluetooth-compatible version providing automatic report generation via an Android smartphone including date, time, measurement value and GPS location.

Up to 2000 data points can be stored internally for later downloading. The dual slim jaws clamp up to 32 mm-diameter conductors. Maximum rated voltage is 600 V to earth and the instrument meets EN 61010 safety standards. Magnetic interference is 10 mA or less in an external magnetic field of 400 A/m at 50/60 Hz.

Power Parameters Pty Ltd
www.parameters.com.au

MULTI-ACTION CONE CRUSHER

Metso has launched the MX4, the first of its MX cone crusher series, into the Australian and New Zealand markets. According to Metso, MX is the first 'multi-action' cone crusher on the market. It combines high reduction ratios with the end-product shape consistency critical in aggregate applications.

Metso's Multi-Action technology automatically optimises crusher operation, being able to simultaneously adjust its setting with a rotating bowl above its cavity and a hydraulic piston inside the machine's fixed shaft. Dynamic setting adjustments can be made when the crusher is operating under full load conditions without the need to stop production. Both rotating bowl and piston adjustments are fully automated. The MX also provides a maximised tramp release distance, delivering high levels of protection against uncrushable objects and overloading. Protection is optimised under all conditions, even with completely new wear parts.

The crusher enables operational cost savings of 10% or more compared with traditional cone crushers, according to the company. Savings in wear components, coupled with an effective and continuous crushing action, bring down the cost per tonne in any quarry or mining application. All the wear parts are accessible from the top of the machine, allowing a complete change-out in just 2–3 h.

The crusher can use up to 70% of the mass of new wear parts. Optimal cavity design, stroke direction and an effectively distributed crushing action are combined to provide an optimised rock-on-rock crushing motion. Quality characteristics of all sized end product fractions stay consistent throughout the lifetime of wear parts.

Metso Australia Limited
www.metso.com

FLOW SWITCH WITH HAZARDOUS AREA APPROVALS

The FS10i flow switch/monitor from Fluid Components International (FCI) has now obtained hazardous area approvals from multiple agencies for a wide range of liquid or gas monitoring applications.

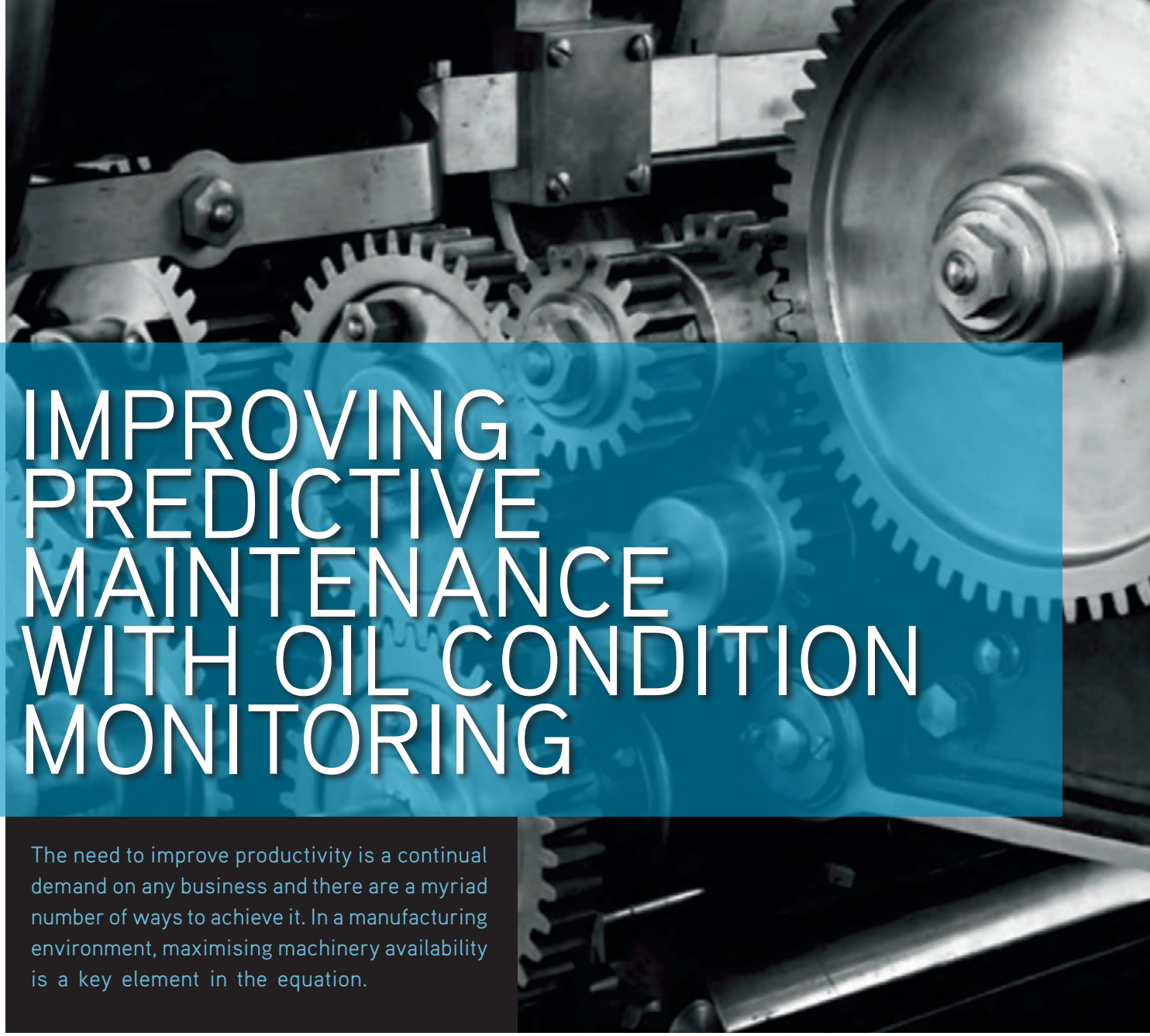
The FS10i has obtained agency approvals that include: FM and FMc for nonincendive, Class I, Division 2, Groups A, B, C, D; Class II, Division 2 Groups E, F, G; Class III, T4@Ta=71°C; ATEX, IECeX nonincendive for gas and dust, Zone 2; EAC (TRCU) Russia, II 3 G Ex nA IIC T4 Gc, II 3 D Ex tc IIIC T81°C Dc, IP64.

Ingress protection meets IP65, IP66, IP67 in non-hazardous locations; CE Marking, CRN, complies with Canadian Electrical code requirements of ANSI/ISA 12.27.01-2011 as a single seal device. It is also said to be the only product in its class to carry a SIL 2 compliance rating per IEC 61508 and has a 90% safe failure fraction (SFF).

In air, gases, water or other liquids, the FS10i flow switch/monitor is suitable wherever detection and user warning is required for a flow rate that is either too high, too low or a no-flow condition is present. Its SIL-2 compliance also ensures a highly reliable flow sensing instrument for repeatable and fast-responding flow trip point or alarm warning within seconds.

The FS10i flow switch/monitor features an air/gas sensitivity and setpoint range from 0.076 to 122 MPS and for water or liquids from 0.01 to 0.5 FPS (0.003 to 0.15 MPS). It is suitable for use in fluid temperatures from -40 to 212°C and pressures up to 138 bar.

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



IMPROVING PREDICTIVE MAINTENANCE WITH OIL CONDITION MONITORING

The need to improve productivity is a continual demand on any business and there are a myriad number of ways to achieve it. In a manufacturing environment, maximising machinery availability is a key element in the equation.

As its name suggests, predictive maintenance aims to determine the condition of equipment in use and predict when maintenance activities need to be undertaken. The objective is to minimise maintenance costs whilst maximising machine availability.

This strategy differs from preventive maintenance, where timed or calendar maintenance is undertaken based on historical or simulation data. The preventive maintenance approach can lead to an unnecessary use of resources when the machinery duty cycle is considered.

Predictive maintenance can offer savings over preventive maintenance by allowing work to be undertaken only when required.

The problem arising with a predictive routine is: how do you determine the condition of the machinery? The causes of failure for a high-speed electric motor, for example, can be very different from a hydraulic system. The measurement of machinery health is defined as condition monitoring, and there are a range of condition monitoring techniques.

The 'big five'

Predictive maintenance is used to measure, through condition monitoring, when maintenance needs to be carried out based on the condition of the machine, helping to prevent unplanned equipment failure.

There are five primary root causes of machine failure: balance, alignment, looseness, lubricant quality and contamination. Alignment and looseness could also be attributed to wear, which can be one of the ways the two conditions arise, with wear leading to contamination.

Within these five broad headings lies an expansive number of ways in which failure can arise. Some of those most frequently encountered are:

1. **Bearing defects:** Bearings invariably operate under heavy, variable loads, often in extreme environmental conditions. With the forces applied to bearings, defects can progress quickly, leading to friction, bearing damage and gearbox failure.
2. **Shaft misalignment:** This can be a common issue due to the temperature changes the shaft experiences, particularly on longer-length shafts. Stress developed inside the shaft can damage couplings, lead to bearing fatigue and even cause shaft breakage.
3. **Couplings:** Damage to couplings can be caused by misaligned shafts, potentially leading to shaft separation. Badly damaged couplings can lead to rotor cracks, gearbox failure and damaged shafts.
4. **Insufficient lubrication:** Bearing wear and gear teeth damage caused by insufficient or contaminated lubrication contributes directly to equipment failure. However, inaccessibility or lack of inspection points can make it difficult to undertake oil condition monitoring.
5. **Broken, worn or chipped gear teeth:** Lack of lubrication can cause excessive wear, as can shaft misalignment, which puts increased load on the input gear and leads to poor gear meshing — both of which degrade the oil by increasing contamination, further exacerbating the problem. Gear damage and misalignment can lead to failure of the gearbox.

This is not a definitive list but is indicative of the range of problems that can result in unplanned downtime and loss of output. There are two condition monitoring techniques that will cover the 'big five': oil condition and vibration.

Pros and cons

Vibration monitoring has been the most popular technique for a number of reasons, primarily because most of the conditions described above will generate some form of vibration. The sensors are usually relatively small and easy to mount on the outside of the equipment, and so can be fitted without stopping the machine.

They operate continuously in real time and can transmit to a PLC or asset monitoring system either hardwired or, in some cases, wirelessly. Alternatively, handheld units are also available, reducing capital outlay but limiting the measurement to where an operator has access.

The biggest difficulty is that the overall vibration signal from a machine is derived from many components and vibration monitoring requires a thorough understanding of the frequency response of all the components. This requires a skilled operator to be able to determine what 'normal' vibrations are, what indicates a change in condition and what level the abnormal vibrations need to achieve to signal an alert. Some systems can be programmed to do this 'filtering' work but still require a trained operator to set the system up.

The other factor to keep in mind is that vibration monitoring normally requires more than one sensor on each piece of equipment. Although each application will vary, a typical motor/gearbox assembly, for example, could require four sensors — two on the motor at the drive and non-drive ends, and on the gearbox input and output shafts. They may also be different measurement types, such as radial and axial.

Although vibration sensors can be low cost, the potential need for multiple devices needs to be considered when evaluating the cost–benefit ratio compared to other monitoring technologies.

Oil condition monitoring is also a popular technique, although, until recently, it too required the use of skilled personnel. An oil sample is drawn off from the machine and sent to a laboratory, where a number of parameters would be measured and a report sent back to the machinery operator. More recently, analysis kits have been introduced that allow the oil to be analysed on-site, but they can have reduced functionality or use less sophisticated measurement equipment.

Although a full laboratory analysis will provide an extensive view of the oil condition and machinery health, it does also have some drawbacks. It is relatively expensive, the oil needs to be drawn off the machine in a repeatable condition and oil sample contamination needs to be prevented.

There is also the delay between sampling and the time taken to receive results. It can be 2–3 days, which introduces a downtime cost — and if a fault is suspected, it may be too long to prevent failure. As with vibration monitoring, the results require analysis by trained staff to interpret and understand them correctly.

The cost of analysis increases with the number of parameters measured and requires access to the machine at a location where the oil can be drawn off before it has passed through filtration. For health and safety reasons, it may require the equipment to be halted while the oil sample is obtained.

In order to retain the benefits of oil condition monitoring but also mitigate the drawbacks, in-line sensors have now been developed. Generally they measure a single parameter but provide continual, real-time analysis and range from particle counters to sensors which measure the viscosity or acidity of the oil, an indicator of the state of the oil itself. They can report their data locally or transmit into an asset management system.

The perfect match?

Oil condition and vibration have reached the levels of usage they have because they can provide a lot of information about machinery health. However, independently they are unable to provide coverage of the 'big five'.

If an electric motor starts to have a problem with a shaft bearing, it is only vibration monitoring that is going to provide the necessary indication of a problem. However, if a bearing is starting to fail in a gearbox, it will deposit debris in the oil before it produces a measurable increase in vibration levels.

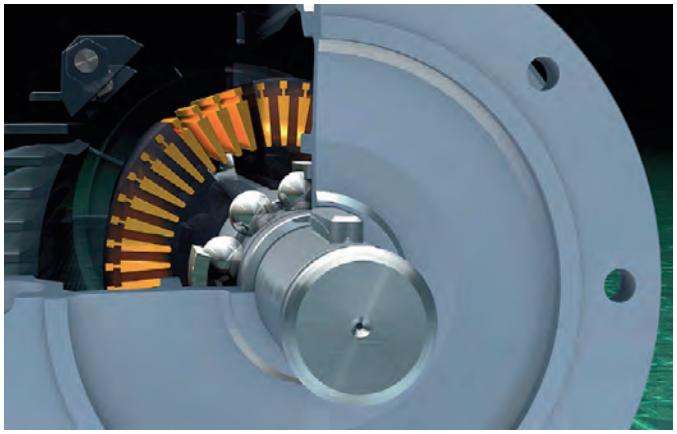
The principle of preventive maintenance is to provide the earliest possible indication of a problem developing, allowing maintenance to be carried out in the most timely, cost-effective way. In some studies it has been estimated that oil condition monitoring can provide up to 10 times earlier warning than vibration monitoring. Oil condition also has advantages in low-speed machinery (<5 rpm) where the amplitude of the vibration signal may not be strong enough to overcome the noise factor.

Monitoring the oil will give an early warning of component breakdown, but gearboxes generally have multiple bearings, so this will not help pinpoint where the exact problem is, which additional monitoring by vibration will assist with.

If vibration monitoring is already in use, would adding oil condition monitoring improve the performance of a preventive maintenance program and provide a sufficient return on investment?

Two is better than one

In an article from *Practicing Oil Analysis* magazine, the example of the Palo Verde Nuclear Generating Station is given[1]. They combined vibration and oil condition monitoring into a common group that worked together.



> ...THERE IS LITTLE POINT IN IMPLEMENTING A PREVENTIVE MAINTENANCE STRATEGY WITH ONLY ONE TECHNOLOGY WHICH DOES NOT, ON ITS OWN, DETECT ALL OF THE MOST COMMON CAUSES OF FAILURE.

In an assessment of bearing defects detected by the technologies, they found that oil condition was responsible for 40% of the defects found, vibration was responsible for 33% and both techniques converged on the remaining 27% of the defects found. The loss of either technology would have reduced their detection performance and their ability to control the root causes of machine failure.

This combination of the two measurement techniques covers the big five causes of machine failure. After all, there is little point in implementing a preventive maintenance strategy with only one technology which does not, on its own, detect all of the most common causes of failure.

An additional function to preventive maintenance, other than simply preventing a breakdown, is to understand the root cause of a failure. The combination of a primary and secondary means of detection provides more data that will enable a deeper understanding of a failure, thereby guiding changes in maintenance, operation or design that will permanently eliminate the cause of a breakdown.

With the arrival of real-time measurement sensors for oil condition monitoring, this combination has become more practical and affordable than the sampling and laboratory technique. The new generation of sensors complement vibration sensors in terms of continuous measurement with outputs that can be accessed locally or combined onto an asset management system dashboard.

The commercial availability of more powerful magnets has also increased the capabilities of ferrous debris sensors. It is now possible to collect larger failure particles as well as wear debris. Capturing the debris allows inspection of the particles, aiding problem diagnosis.

Gearboxes, for example

For an example of this complementary approach, let's look at gearboxes.

Pretty much every plant in the world uses gearboxes, which are tough on most lubricants because of heat, aeration and chemically active particles. Likewise, misalignment, imbalance and looseness are also a risk.

Occasionally gears go wrong, with gear tooth wear and gear tooth fracture the most common failure modes. Using vibration analysis to detect wear-related gear faults can be challenging due to the number of competing vibration signals. Oil condition, on the other hand, can provide excellent results in detecting contact fatigue, abrasion and adhesive wear, making it an ideal choice for early detection of these modes of failure.

However, it is unlikely that breakage of a gear tooth will produce a detectable quantity of wear particles, especially if the failure is caused by a sudden impact or defective material. By monitoring the gear mesh frequency using vibration analysis, a broken gear tooth would be pinpointed every time.

Together, vibration and oil condition come together for monitoring the essential health of gearboxes.

Conclusion

We have seen that detecting and analysing machine faults requires both oil condition monitoring and vibration analysis:

- Both methodologies are required to understand and manage the root causes of machine failure.
- In many cases, one technique will serve as the primary indicator with the other as the secondary confirmation.
- Oil condition is generally stronger in failure detection for gearboxes, hydraulic systems and reciprocating equipment.
- Vibration analysis is generally better in detecting high-speed bearing failures and localising the point of failure, depending on the application.
- For determining which wear mechanism is inducing failure, oil condition is often stronger.
- Correlation between oil condition and vibration analysis is very good, but there can be contradictory instances.

By combining oil condition and vibration monitoring, a number of benefits compared to conventional condition monitoring practices can be realised. These include accurate, efficient and early fault detection, as well as the ability to perform root cause analysis.

Reference:

1. Johnson B 1998, 'Oil Analysis Success at a Power Generation Station', *Practicing Oil Analysis*, July 1998.

Control Devices Australia
www.controldevices.net

3-IN-1 CALIBRATION SYSTEM

The Ralston FieldLab is a 3-in-1 gauge, calibrator and reference recorder, providing a measurement uncertainty of 0.1% of reading, the ability to store and run predefined calibration procedures and a 2 million-point data recorder.

The product is fully temperature compensated from -10°C to 50°C, certified for Zone 0 hazardous locations and IP67 rated to allow 1 m submersion for up to 30 min. A 3.5″ colour TFT display provides clear, easy-to-follow instructions and a 4.8 Ah lithium-ion battery and built-in power handling mechanisms ensure the unit can easily handle continuous recording for months at a time.

Using the included software, templates can be created and loaded onto one or more FieldLab devices. In the field, onscreen prompts allow the selection of the relevant test mode; the user is then led through the test sequence, with immediate feedback provided on whether the device under test is out of tolerance. Datasets can subsequently be downloaded to a PC and data can be exported or provided directly as a PDF.

The unit is offered as a single device or as a comprehensive portable calibration kit, with a suitable pressure source, hoses and adapters.

Transtek Pty Ltd

www.transtek.com.au

ADD-ON WIRELESS ACCESS POINT

HMS Industrial Networks has introduced the Anybus Wireless Bolt, a wireless access point designed to be mounted on a machine or cabinet to give it wireless access via WLAN, Bluetooth or Bluetooth Low Energy. This access makes it possible to do configuration via a regular tablet or smartphone or connect to a cloud service.

The Anybus Wireless Bolt is mounted onto a machine or cabinet (just like a bolt) to give it a robust IP67 wireless interface. It is typically used for configuration purposes. For example, the Bolt makes it possible to use a device such as a tablet or smartphone to connect to a machine and use it as an HMI. Another typical use case is connecting a machine to a cloud service.

The Wireless Bolt can communicate wirelessly up to 100 m via WLAN, Bluetooth or Bluetooth Low Energy. On the wired side, the Anybus Wireless Bolt can communicate with devices via serial (RS232/485), CAN or Ethernet. Regardless of communication method, it has the same connector (2x9p Plug Connector) for both power and communication.

Global M2M

www.globalm2m.com.au

NEW PRODUCTS

MEASURING LIGHT CURTAIN WITH PROFINET

The Leuze electronic CML 700i is a measuring light curtain in IP65 housing with an integrated Profinet interface. With Profinet as well as the control unit integrated in the receiver unit, the need for additional devices and software is eliminated.

Configuration is carried out directly via the large display, using Leuze Sensor Studio or directly via the PLC, which saves the settings and makes it possible for devices to be replaced without having to reconfigure. The light curtain is equipped with an integrated switch for setting up a ring or linear topology. Through cascade mounting with a dead zone of just 23 mm between beams, fast response times and the detection of transparent objects, the light curtain is able to perform gapless object tracing, for example, on conveyor lines.

The data can be transmitted with a speed of 100 Mbps. Depending on the length (up to 2880 mm), the measuring light curtain makes the data available cyclically within 1 to 53 ms. The maximum length of the measurement data is 222 B and the individual values of the individual beams can be output so that an evaluation of height, width or orientation can be realised easily and quickly.

Leuze electronic Pty Ltd
www.leuze.com.au

DEVICE COMMUNICATOR

The Emerson AMS Trex is an intrinsically safe HART and FOUNDATION Fieldbus device communicator that allows technicians to configure, isolate, diagnose and repair problems while devices continue to run, using its 'Power the Loop' function and onboard ammeter. It is available to rent from TechRentals.

Power the Loop is a built-in capability used to power devices, enabling technicians to isolate a particular device from the rest of the system. This helps to pinpoint issues with installation, power supply, wiring, I/O cards and configuration. Segment and loop diagnostic tools quickly validate loop and fieldbus segment characteristics for easy troubleshooting.

The device features a 5.7″ resistive touchscreen display; built-in Bluetooth, USB and Wi-Fi connectivity; 32 GB of application memory; and Upgrade Studio PC software application.

TechRentals

www.techrentals.com.au

TERMINAL MANAGEMENT SOFTWARE

Emerson Automation Solutions has released TerminalManager, its next-generation software for managing terminal operational and commercial activity. TerminalManager provides a single software platform to manage the entire terminal business process, helping operators streamline loading processes, achieve greater connectivity to customer needs and close the books faster.

Today's terminal operator is faced with a variety of challenges to remain profitable in an increasingly complex market environment. For terminal operators in the oil and gas, chemical and refining industries, efficiently maximising the throughput of the terminal is critical. TerminalManager helps terminal operators manage the entire terminal business process by managing customer contracts and orders through a web-based portal, efficiently planning and executing the loading operations, managing book and physical inventory, charging for services and billing activity back to the customer.

The product is designed to not only move products but also to efficiently move information. This optimises the order-to-cash cycle for the terminal and helps streamline the operator's supply chain logistics activities.

Emerson Automation Solutions

www.emersonprocess.com.au

OPEN-FRAME TOUCH MONITORS

The Advantech IDS31 industrial touch monitor series offers a flexible mechanical design. Available in eight screen options ranging from 7″ to 32″ in both 4:3 and 16:9 sizes, the open frame chassis system is designed for rear mounting to existing panels or new designs alike. The IDS31 series is equipped with a mechanical design that allows for both touch and non-touch versions as standard, and which can even be adapted to alternate touch technologies such as surface capacitive or surface acoustic wave for low minimum order quantities and without the need for additional NRE costs. The design has been developed to minimise bezel frame dimensions and incorporates the standard VESA 75 x 75 or 100 x 100 mounting system.

Each design in the IDS31 series has an optional black powder-coated cover (available with low MOQ) to enable the user to specify a closed frame construction allowing surface, pole, arm or other standard VESA mounting systems. It also provides a wide range of user-configurable options such as touch technologies, high brightness and HDMI/Displayport interface.

The IDS31 series is designed with narrow bezels and the reduced thickness makes for good aesthetics in the end product along with a wide viewing angle and contrast for both portrait and landscape usage. Its narrow bezels and slim design maximise its usable area and minimise the challenges of industrial integration. It is fitted with its own video interface card with DVI/VGA inputs and optional USB for a touch screen interface.

Advantech Australia Pty Ltd
www.advantech.net.au

OPC UA SOFTWARE DEVELOPMENT KIT

Honeywell Process Solutions has announced a software toolkit that simplifies the interconnection of industrial software systems, enabling them to communicate with each other regardless of platform, operating system or size. The Matrikon FLEX OPC Unified Architecture (OPC UA) Software Development Kit (SDK) is also designed for applications where minimal memory and processing resources are common.

Intended for use by discrete and process industry manufacturers, commercial customers and automation original equipment manufacturers (OEMs), Matrikon FLEX is claimed to be the first high-performance developer toolkit that quickly and easily enables any application, regardless of size, with OPC UA.

Growing adoption of the IIoT and Industry 4.0 is driving requirements for open and secure connectivity between devices and for edge-to-cloud solutions. Since OPC UA serves as a key data connectivity standard, vendors are seeking to enable their products with this technology to compete in the IIoT/Industry 4.0 landscape.

Matrikon FLEX incorporates embedded-first principles, which makes the toolkit small and suitable for use in resource-constrained applications. Due to its low memory requirement, it operates efficiently so there are sufficient CPU resources for correct device functionality.

With its 'server/client-in-a-box' design, the toolkit provides a fast, seamless method of implementing optimised OPC UA products without requiring development personnel to be OPC UA experts. It also employs a robust design to maximise product uptime, allowing OPC UA to be implemented in products with minimal computing resources.

Honeywell Process Solutions
www.honeywellprocess.com

STEPPER MOTION CONTROL RANGE

IDEC Corporation has introduced a line of motion control stepper products in conjunction with Advanced Micro Controls Inc. (AMCI). This AMCI by IDEC range includes controllers, stepper motors, an integrated controller/drive, an integrated drive/stepper motor and an integrated controller/drive/stepper motor. When combined with an IDEC FC6A PLC and its embedded motion control macro instructions, these devices allow users to quickly and simply implement single- and multi-axis motion control in a wide range of industries and applications.

Many industrial applications require motion control, but users are often frustrated by the complexity and high cost of implementation, particularly with servo systems. IDEC and AMCI have partnered to address this issue by offering a simple yet highly capable stepper motion control system. Macro instructions embedded in the PLC WindLDR programming software can be configured with drag-and-drop commands to perform control of up to 12 axes.

The integrated controller/drive and drive/stepper motor units simplify installation by combining multiple components into a single unit. The integrated controller/drive/stepper motor units offers space saving and system simplification.

Because all the components and the software modules are provided by IDEC and AMCI in close partnership, users are assured of correct operation right out of the box, with no need to perform integration among the components.

Compared with servo motion systems, steppers are a simpler technology and require no tuning or adjustment. They also have high torque at low speeds, do not require position feedback and have low maintenance requirements.

IDEC Australia Pty Ltd
www.idec.com/australia

NEW PRODUCTS

HYDROSTATIC SENSORS

BD Sensors has released the LMP307 hydrostatic sensor. With an accuracy of 0.1% FS, the sensor provides continuous level measurement in industrial clean or recycled water, waste fluids and fuel applications.

The sensor includes over 100 variations to ensure each sensor is individually paired to the correct application. It caters to scenarios such as custom cable lengths, level measurement up to 250 m deep, electrical output type and SIL2 certification suitable for hazardous areas.

For diesel fuel or applications where temperature measurement is critical to volume measurement, the LMP307T version includes a PT100 temperature sensor in the same housing, featuring a separate output for submerged level measurement.

Both the LMP307 and LMP307T level sensors are suitable for use in drinking water systems, wells, bore holes and water treatment and recycling facilities, as well as for diesel fuel tank volume measurement for single generators and large-scale tank farms.

Control Logic Pty Ltd

www.control-logic.com.au

LASER FOR REFLECTIVE SURFACES

The Micro-Epsilon optoNCDT 2300-2DR blue laser sensor is specially designed for displacement and distance measurements on directly reflecting surfaces. The compact sensor operates at high speeds on these surfaces and provides maximum precision in the nanometre range.

It can be used for thickness measurements of flat glass, distance measurements on annealed glass and assembly monitoring of extremely small parts. The measuring rate can be set up to 49 kHz, making the sensor suitable for process monitoring tasks. While operating with advanced real-time surface compensation (A-RTSC), the sensor enables a precise real-time surface compensation of different surface types. Data output is via Ethernet, RS422 or EtherCAT.

The sensor is designed for a parallel installation to the measured object. The blue laser light is directly reflected onto the receiving optics by the measured object and, unlike red laser light, the blue laser light does not penetrate the object. A sharp point is projected onto the surface, which enables a stable signal on the receiver element— achieving nanometre resolution. In addition, the extremely small laser spot size allows the sensor to detect very small objects.

Bestech Australia Pty Ltd

www.bestech.com.au

RE-USABLE SINGLE-GAS MONITOR

Scott Safety has introduced the Protégé SG, a versatile, re-usable, single-gas monitor that is configurable to detect 13 different gases.

The product is a universal portable gas detector with features such as smart plug-and-play sensors and a replaceable lithium battery that provides unlimited life. The swappable sensors are equipped with a smart sensor board that automatically recognises sensor type and updates the gas label on the LCD display while automatically downloading the necessary calibration parameters.

With an IP66/67 rating, global regulatory approvals, multiple languages accessible on the LCD and internal data logging for up to 5000 events, the product provides industrial workers and first responders maximum flexibility to focus on the task at hand and not on their equipment.

The range of monitors includes the MasterDock II, an expandable docking station with up to 10 bays. The MasterDock II has Ethernet and USB connectivity and supports six gas bottles simultaneously with the ability to bump, calibrate and charge each device. Software allows users to print certificates, configure monitors and centralise data storage for improved fleet management capabilities.

Scott Safety

www.scottsafety.com

PARAMETERISABLE POWER SUPPLIES

Phoenix Contact has released a parameterisable power supply. The QUINT POWER IV includes added features that allow the user to tailor it to suit their required output behaviour and preventive function monitoring.

The QUINT IV's output characteristics, signalling and voltage can be adjusted to the user's exact requirements. Components such as the output characteristic curve can be individually altered due to parameterisation via the integrated NFC interface using a smartphone or PC. Users can also tailor signalling thresholds to suit the requirements of applications to save time and minimise default errors. The current, voltage and power can be set differently depending on use and needs.

Integrated Selective Fuse Breaking (SFB) technology delivers six times the nominal current in up to 15 ms and thereby selectively trips standard circuit breakers safely and quickly, while loads in parallel are unaffected and continue working. The static boost feature also continuously provides up to 125% of the nominal current. To start heavy loads, the dynamic boost provides up to 200% of the nominal current for up to 5 s.

The QUINT IV's diagnostics constantly monitor system-specific, critical operating states and report errors before faults occur. In addition, integrated gas-filled surge arresters offer a high degree of immunity as well as a mains failure buffer time of more than 20 ms.

In addition to providing no-load losses, the devices can be switched to an energy-saving sleep mode via the integrated remote input. The QUINT IV has an operating temperature range of -40 to +70°C.

Phoenix Contact Pty Ltd

www.phoenixcontact.com.au

NEW PRODUCTS

DISTRIBUTED I/O PLATFORM

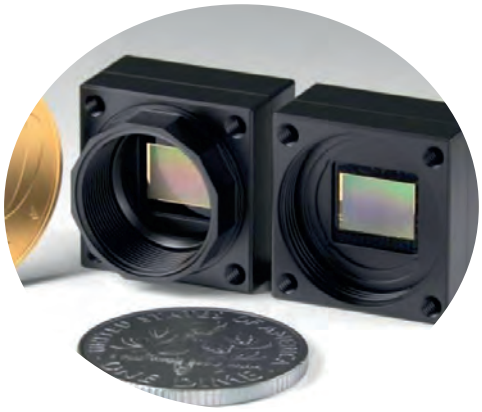
Red Lion has released a rugged E3 I/O Ethernet-enabled distributed I/O platform that extends digital and analog control. The platform is suitable for remote stand-alone applications including PLCs, RTU systems and high-density I/O, along with Red Lion's Graphite HMIs.

E3 I/O high-density modules offer up to 34 mixed I/O points to meet varying requirements and are able to withstand -40 to 75°C temperatures. The all-metal housing features 16-bit resolution with 0.003% accuracy, 1 ms analog sampling options and 50 kHz high-speed counter inputs.

Robust networking capabilities and real-time monitoring are achievable via the built-in web server, while the device is equipped with versatile built-in serial ports. Dual Ethernet ports provide a variety of network modes, including real-time redundancy for ensured reliability.

Red Lion's Crimson 3.0 software, which is included, is a programming platform that unlocks the power of E3 I/O modules with simple drag-and-drop, point-and-click configuration. The platform is suitable for a wide array of industries, including water, wastewater, manufacturing, power and energy, mining, and oil and gas.

Control Logic Pty Ltd
www.control-logic.com.au



SUBMINIATURE INDUSTRIAL CAMERAS

Ximea xiMU industrial cameras offer 5 MP resolution and weigh only 3.4 g. Compatible with Windows, Linux, Mac OSX or ARM platforms, the compact cameras are suitable for integration into tight spaces. With their low power consumption and flat ribbon flex cable, they can be used for embedded vision systems and applications such as 3D scanning, robotics, material science microscopy, flat panel inspection, UAV and kiosks.

The industrial cameras come in either colour or monochrome versions. They measure 15 x 15 x 8 mm, with a 13 x 13 x 3 mm board-level version also available. Offering the Aptina MT9P031 sensor and supporting GenTL/GenICam, the cameras are suitable for synchronising several units into one solution or for utilisation in portable systems.

The cameras feature two digital inputs, two outputs and USB 2.0. They have low power consumption (under 1 W) and low thermal dissipation. They are compatible with more than 30 machine vision libraries.

SciTech Pty Ltd
www.scitech.com.au

VALVE ACTUATOR

Alfa Laval's Unique DV-ST UltraPure actuator is designed to fit all of its standard diaphragm valves. It simplifies inventory management and makes the specification process quick, easy and secure. Regardless of the process or application, the same actuator can be stocked as a spare part for all Alfa Laval Unique DV-ST UltraPure diaphragm valves.

The actuator withstands the high temperatures required for sterilisation. It operates at working pressures up to 10 bar (6 bar TFM/EPDM) and is able to close the valve at the same working pressures at 0% pressure drop.

Alfa Laval sensing and control units can be easily integrated with the actuator, which enables users to take advantage of the company's valve automation solutions. Alfa Laval sensing and control units feature tight tolerance bands to provide maximum process safety and no-touch, set-and-forget sensors with simple set-up. This minimises human error and promotes safe and efficient production, ensuring more uptime.

Alfa Laval Pty Ltd
www.alfalaval.com.au

COMPRESSORS

Kaeser Compressors has announced its latest generation FSD series rotary screw compressors, enabling air cooling of rotary screw compressors for larger drive powers over 250 kW.

The radial fan in Kaeser's cooling system draws in ambient air directly through the cooler without being pre-warmed to ensure optimum cooling performance. FSD compressors can therefore be used in ambient temperatures as high as 45°C. All FSD models are also optionally available as water-cooled versions.

In every model, the thermostat-controlled radial fan for fluid cooling helps achieve further energy savings. It is integrated into Kaeser's Electronic Thermo Management (ETM) system, which regulates oil temperature to ensure a safe and consistent differential from the dewpoint temperature, thereby avoiding unnecessarily high compressed air discharge temperatures and leading to additional energy savings. With the heat recovery option, a second ETM system assures optimised usage of the available heat energy.

This optimised efficiency results from the refined screw compressor blocks equipped with high efficiency and flow optimised Sigma Profile rotors. In addition, the screw compressor block is directly driven by an energy-saving motor that operates at a low speed of 1490 rpm. Direct drive reduces energy consumption, maintenance requirement and sounds levels.

The FSD.3 series rotary screw compressors are available with drive power 250 and 315 kW, working pressures 7 to 15 bar and free air deliveries from 29.2 to 58 m³/min.

Kaeser Compressors Australia
www.kaeser.com.au

DC-DC UNINTERRUPTIBLE POWER SUPPLY

Omron's S8BA series of DC-DC uninterruptible power supplies (UPS) is designed to produce a steady 24 VDC output for industrial-purpose computers (IPC) and controllers. Designed to work with the S8VK-S series switch-mode power supply, the combination will work in a wide range of temperatures from -40 to 70°C.

The S8BA can be DIN rail mounted and uses push-in plus terminals for quick and effective connections. It features audible alarms and test buttons to perform self-diagnosis and can provide power for over an hour without mains (depending on load and capacity of the unit).

The S8BA is available in various models for 120, 240, 360 and 480 W and conforms to UL standards for overseas export. It features lightweight lithium-ion batteries for their compactness and efficient industry-grade life expectancy of 10 years (replacement battery packs are available). In addition, it is equipped with three sets of communication interfaces including USB, RS-232C and I/O ports. This permits recognition of interlock shutdowns with an industrial PC or controller.

Omron Electronics Pty Ltd
www.omron.com.au

SMALL ROBOT WITH COLLABORATIVE SAFETY

ABB Australia has announced that SafeMove2 is now available for IRB 1200, the smallest ABB robot to feature its safety-certified monitoring and control software.

SafeMove2 enables people to work safely alongside ABB robots with payloads ranging from 6 to 800 kg, without compromising productivity. It also provides an optimum level of collaboration and flexibility to higher speed and throughput applications which typically require more insular, intrusive levels of safety.

SafeMove2 includes a range of cutting-edge safety functions, including safe speed limits, safe standstill monitoring, safe axis ranges, and position and orientation supervision. It allows robots and operators to work more collaboratively and closer together by restricting robot motion to precisely what is needed for a specific application.

SafeMove2 simplifies production scenarios and provides tools that speed up the commissioning workflow for faster set-up and validation. The innovative software option also integrates safety fieldbus connectivity into ABB's IRC5 robot controller family as well as the IRC5 Single, Compact and Paint controllers.

First introduced in 2014, the IRB 1200 addresses the needs of the material handling and machine tending industries for flexibility, ease of use, compactness and short cycle times while still maintaining a large working envelope.

ABB Australia Pty Ltd
www.abbaustralia.com.au

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NEW PRODUCTS

COOLING UNITS AND CHILLERS WITH IOT CAPABILITES

Rittal has released cooling units and chillers with IoT capabilities. Its Blue e+ cooling units and chillers consume an average of 70% less power than their conventional counterparts and include M2M communication capabilities, being able to transmit key data to a smartphone quickly and simply via an NFC (near-field communication) connection. Built-in RiDiag III parameterisation and diagnostics software uses a USB interface or a network to support efficient system operation, deliver rapid support for maintenance and repairs and enable in-depth diagnostics.

The Blue e+ communications module (Com Modul) also allows the cooling units and chillers to communicate with any higher-level system via OPC UA, Profinet, SNMP, Modbus RTU and CAN Master, enabling predictive maintenance and data analytics. Rittal has demonstrated use cases in which the units interact with Siemens MindSphere and IBM Watson IoT.

Rittal Pty Ltd

www.rittal.com.au

DESKTOP LASER SINTERING 3D PRINTER

Sintratec is a Swiss company that specialises in the development and production of desktop laser sintering 3D printers. Laser sintering makes it possible to print complex objects without the need for additional support structures, making it possible to produce free-form movable parts.

Laser sintering 3D printers typically require special on-site installations such as industrial ventilation systems, high-voltage power supply or pressurised air and a dedicated floor space. Sintratec's S1 in contras is an SLS printer in a compact desktop footprint, weighing only 67 kg and powered by 230 V mains power.

The product uses a high-precision diode laser, providing detailed and smooth print results. The print material used is Sintratec's PA12 industrial-grade polyamide (nylon) powder. With a melting point of 176°C, PA12 allows users to print strong, temperature-resistant, precise and durable work pieces.

The printer features a build volume of 130 x 130 x 180 mm and layer height of 100 μm. The printed parts can be used for functional prototypes in mechanically demanding applications and end products with a high mechanical load capacity and high long-term stability. The technology is particularly suitable for prototyping free-form moveable parts and small-scale production runs.

The Sintratec S1 comes with Sintratec Central Software, which allows users to easily import 3D objects and to start and manage print jobs.

Emona Instruments Pty Ltd

www.emona.com.au

OIL-FREE SCROLL COMPRESSOR

Boge Compressors has extended its EO range of scroll compressors to ensure full protection from contamination, with the EO 11 producing oil-free compressed air in the 11 kW performance segment. Its compact design, combined with operation at a minimum of 59 dB(A), means there is no problem installing the system next to the workplace.

BOGE's eccentric oil-free (EO) compressors meet the requirements of oil-free compressed air for sensitive applications due to the scroll compressor technology which operates without oil lubrication. The aluminium spirals in the compressor chamber interlock but do not touch. The resulting compressed air is pulsation-free and free of oil.

Up to four compressors can be installed in the housing of the compressor to ensure flexible adaptation to the compressed air demand. At 10 bar the EO series can cover delivery rates from 490to 1960 L/min, while at 8 bar the supply of compressed air ranges from 620 to 2480 L/min. Featuring a modular design, the EO series can be ordered with an integrated or separate refrigerant compressed air dryer, mounted on a container or as a double or multiple system.

Like the EO 17, the EO 11 is available as an upgrade version. This enables the two-stage compressor to be extended to include a third compressor stage or an integrated refrigerant dryer. The system comes with the electrical system required, thereby offering users flexible options for retrofitting. The machine features an optimised space-saving design, as EO system solutions are no wider than a standard doorway.

Boge Compressors Ltd

www.boge.net.au

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Stephen Woolger
Manager Health & Safety
Gold Coast 2018 Commonwealth Games Corporation

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Product Services Global Sales Manager
SAI Global

Michael Tooma
Partner
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Tim Fleming
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AS I SEE IT

INNOVATION IN MINING

The Australian mining industry is in a state of flux. Companies are faced with heightened pressure to reduce operating costs, maximise production and ensure uptime, while the need to remain compliant with environmental and safety regulations is ever present. Mining companies devote significant time and effort to addressing these challenges, yet many of the methods and practices applied are dated and inefficient. With recent advancements in technology, the adoption of digital innovation in the mining industry has the power to drive efficiency, lift productivity and, ultimately, increase profits.

The fundamental drivers of business have not changed: streamlined and optimised operations, asset performance, people productivity, and health and safety. What has changed, though, is the digital, technology and innovation landscape.

It is predicted that 50 billion devices will be connected to the internet by 2020. In this new, connected world, referred to as the Internet of Things (IoT), there is huge opportunity to realise the value of the data generated by these devices through the adoption of innovative, integrated digital solutions.

Some companies aren't convinced by the role of digital innovation; while 'experiment and fail fast' is a common belief held by small start-ups, this approach can feel uncomfortable for larger businesses. However, it's important to understand that innovation often means favourable incremental gains, rather than massive transformational change.

Through the adoption of new digital technologies, the mining industry is beginning to acknowledge and appreciate the impact of innovation on their resource base, supply chain and equipment assets.

There are plenty of examples of how innovative technologies are driving improvements in the industry. For one, pattern recognition and process modelling is increasingly being used with systems learning. Drawing on this technology, predictive analytics with unique, advanced predictive algorithms can identify subtle changes in equipment behaviour and raise early warning signs of equipment performance and health problems.

Mobile technology is increasingly being utilised for data collection, inspections, performance and health monitoring, from process to people, in the field or off-site. Adaptive real-time supply chains will drive extraction sequences with production linked to market demand, process changes and financial constraints.

Immersive virtual reality can offer a lifelike 3D environment for training, testing and process simulation. It enables training and simulation of plant safety procedures, even for remote or hard-to-access locations.

In the data storage and analysis space, cloud computing software-as-services technologies will allow mining companies to have access to applications and information with less IT infrastructure, licensing management and hardware. And with the emergence of edge computing, critical processing, collection, validation, information sharing and smart decision-making will be brought closer to the data source.

In the new world of digital mining, the adoption of the Industrial Internet of Things (IIoT) and digitisation is a growing business imperative. To make the most of this new world, mining organisations must overcome the mental barriers that prevent action. Adopting innovations in your business need not mean 'all or nothing'; innovation can be just as transformative when it's done incrementally.

Stewart Johnston is Schneider Electric's Enterprise Solutions Manager for life cycle management of Ampla, Wonderware MES, Spiral Planning & Scheduling, Intelligence EMI and Avantis EAM in the Pacific region. He is uniquely experienced in the design and implementation of fully integrated ERP/MES and control solutions for mining, resource and manufacturing operations and how to use those systems to optimise and improve the production, quality and supply chain processes. Stewart has a Diploma of Metallurgy and IT qualifications in network and web design along with over 17 years of experience designing and implementing MES to meet customer business needs — the last eight years with Schneider Electric.

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