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AMS Instrumentation & Calibration Pty Ltd
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THE KAIZEN PARADOX

*Paul Stringleman**

How incremental improvements can impede innovation
in the automation of warehousing and distribution.



Kaizen. It is a word synonymous with improvement in organisations around the world. While the Japanese word literally means ‘improvement’, in industry and business the focus is on small, continuous steps to better processes. It is embedded in the management thinking of many organisations.

Japanese businesses developed Kaizen practices around the 1950s, most notably Toyota as part of its Toyota Production System. After studying why the company was so successful at high-volume production of high-quality vehicles in the 1960s, Masaaki Imai wrote several books on Kaizen and formed the Kaizen Institute, spreading the knowledge and practice around the globe.

However, there are times when Kaizen is not enough. Worse still, a small improvement can often hold an organisation back, perhaps even stifling significant development.

This is known as the *Kaizen Paradox*.

In the 1980s, author and business professor Oren Harari famously pointed out that not everything that exists could have been developed by continuous improvement alone. This idea is captured in another Japanese word that is less well known but equally important: *Kaikaku*.

Kaikaku means ‘radical change’. It describes the other side of improvement: the major step forward, or big leap. An analogy is a home illuminated by candles; while Kaizen improves upon the candle, Kaikaku is the installation of electric light.

Kaikaku is a less famous but equally important part of the Toyota Production System and is often overlooked by organisations in their rush to embrace Kaizen.

The Kaizen Paradox and the issues it creates

By focusing exclusively on small improvements, an organisation may miss an opportunity to gain a competitive advantage in costs and customer service. If competitors take a big leap, an organisation will be left behind, still making candles in a light bulb market.

Small improvements also commit resources that could be better spent towards

a larger step forward in performance, or with more strategic planning, could have contributed to a major change.

Finally, when a Kaikaku opportunity exists, the Kaizen path weakens the Kaikaku ROI and productivity can plateau at a lower level. This is the Kaizen Paradox at work.

For example, many businesses rightly identify the need for warehouse automation but make the assumption that they need to ‘start small’. Yet unless the interim investment is part of a planned larger final system it could be a false start.

Figure 2 is a graph of productivity versus cumulative ROI per investment. Each smiley face refers to a successful implementation of an investment with an ROI period of under three years. Each letter (A, B, C) represents different investment and improvement pathways taken by three companies. They all start off in a manual and unimproved state at 50 order lines per picker per hour. Company A makes the leap to full automation and thereby achieves the highest productivity level of all three (500 order lines per picker per hour). Company B and C both understand the benefit of automation but decide to start smaller. Company B invests in a mechanised solution and achieves 150 order lines per picker per hour. Company C upgrades its warehouse management software (WMS) and achieves a modest 100 order lines per picker per hour.

In a second round of investment, Company C, which is still a manual warehouse but with smart warehouse management software, has a choice to make — C1 would be to invest in a fully automated solution to sit under its new WMS. The second pathway (C2) would be to make the smaller investment in mechanisation of its manual warehouse. Both investment paths would achieve an ROI under three years, and so either pathway would get approval.

Company B’s warehouse managers eventually decide that the time has come to automate. They investigate the cost and find the ROI doesn’t stack up any more (it is over three years) — so they fail to automate. They understand why — their



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base level of performance has increased through mechanisation, but the cost of the automation is much the same as it was.

In a third round of investment sometime later, company C2 discovers the same problem. Even though its baseline performance has improved, the return on investment period for full automation extends to more than three years. In summary, 50% of the four investment pathways to automation were unsuccessful due to the smaller improvements that have already been made.

This is the Kaizen Paradox at work.

It is important to note that ROI limits for investment are contributing to the Kaizen Paradox that companies are experiencing. To solve this pitfall, companies should review their ROI restrictions for warehouses with existing mechanised systems already in place.

The Paradox in practice

In a recent real-world example, a company was seeking to identify a solution for an automated 'goods-to-person' warehouse in a bid to achieve a significantly higher level of business performance.

However, a year earlier the company had invested in a mechanised 'zone-to-zone order picking' solution, consisting of conveyers and carton storage shelving.

Although the project was still in the commissioning phase, senior management could see that the solution wasn't going to meet their long-term requirements. Fortunately, the mechanised solution didn't occupy the

entire warehouse, making it possible to build an automated goods-to-person solution on the same site.

Developing a business case for a goods-to-person automated solution, the company gathered quotes to either move the zone-to-zone solution, redesign it or scrap it altogether.

It soon became clear that the mechanised system made it much harder for them to proceed with the automation required, as the business had invested a large sum on a now largely redundant piece of equipment that occupied a prime position in the warehouse. Unless the mechanised system could become part of the fully automated solution, the company also faced the cost and embarrassment of scrapping the new installation.

While the mechanised system improved productivity from 50 to 150 order lines per hour per person, the automated goods-to-person system would deliver 500 order lines per hour per person. As a result, almost a third of the productivity gain that would have been realised in going from a manual to an automated operation was already delivered by the mechanised system. In a simple accounting approach this worsened the business case, extending the ROI of the desired automated system by an extra year. Because the mechanised system could not be incorporated in the automated solution, there was no reduction in the cost of the required automation.

This Kaizen Paradox hasn't only occurred to this one organisation and doesn't only occur in the case of zone routing solutions in warehouses. It is just one example of a common predicament for many businesses, where investments are made to achieve productivity gains, but in doing so they dilute the business case for a better investment, causing them to plateau at a lower level of productivity.

Tools and approaches to support best practice

Both manual and mechanised warehouses involve 'person to goods' in some form. The difference being the way the order tote moves around the facility, trolley or picking truck to conveyor, and the addition of WMS software to control order picking more efficiently. These improvements have helped reduce the time between pick operations and gradually lift productivity from around 50 to 150 order lines per hour per picker.

The Kaikaku occurred when goods-to-person technology was developed that radically transformed the way orders were picked, allowing a stationary worker or a robot to pick from products delivered to them in sequence. This can typically boost individual picker performance to between 500 and 1000 order lines per hour and minimise the labour required, while at the same time significantly reducing the warehouse footprint due to higher density storage.

An automated goods-to-person warehouse can typically achieve the same throughput as a manual or mechanised operation, with around half the staff and in half the building size. As a result, a strategic approach to automation can save significantly on the cost of warehouse expansion or remove the need for relocation, prolonging the life of the existing facility.

In the age of Industry 4.0, we have many tools that enable us to accurately model and predict the performance of solutions. Real product master and order line information



Figure 1: Kaizen and Kaikaku.

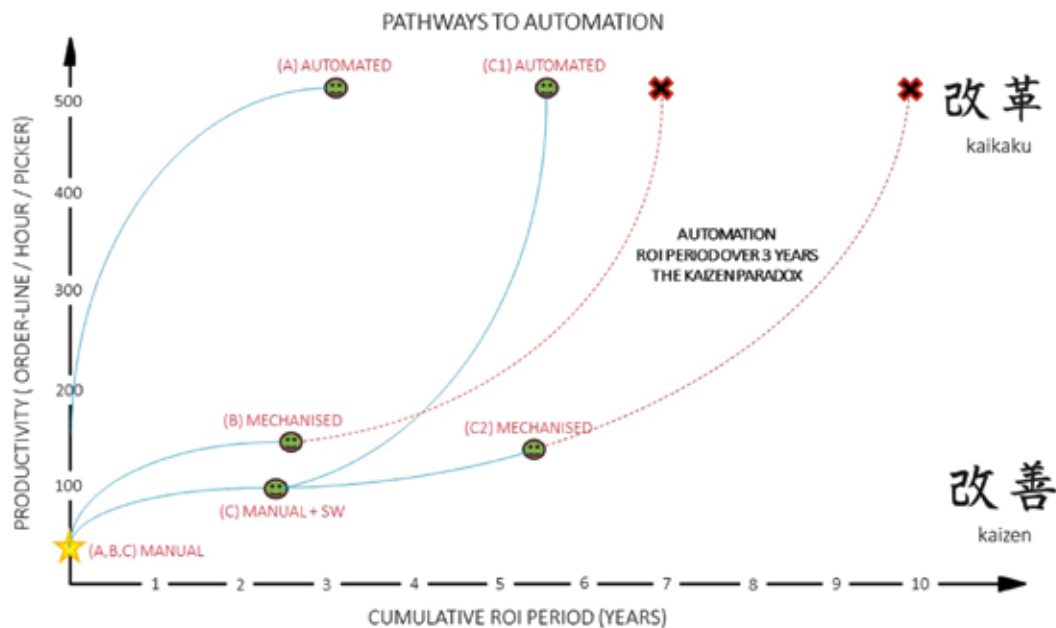


Figure 2: Productivity versus cumulative ROI per investment — three approaches.

can be used to simulate and emulate each type of technology and test its productivity impact.

Using new virtual reality tools, it is possible to build an automated solution in cyber space and take a virtual tour, watching as orders are assembled and dispatched, confirming the effectiveness of the solution before being purchased. This 'cyber-physical' approach allows an organisation to perfect their new operation and make the greatest Kaikaku advance before any physical system is built.

Also, as many advanced technologies are modular and can scale with growing demands of the business, the combination of predictable and adaptable performance effectively eliminates business risk, freeing executives to make investment decisions with greater confidence.

This more strategic approach to Kaikaku can protect an organisation from being trapped in a focus on low performance operations: being cursed with the Kaizen Paradox.

Next steps for boards and managers

For many of the most successful organisations, major leaps forward in performance are approached strategically. Kaikaku investment is made before Kaizen improvement.

Before embarking on a technology path or even selecting a building, businesses

should consider their long-term requirements and how technology could be implemented.

It may be achievable in phases if this is planned from the start. Use of an Industry 4.0 approach and modular systems can significantly mitigate long-term business risks.

Strategic improvement plans are more robust when they consider costs that could have been avoided. These could include land and buildings, equipment, labour and the cost or service issues associated with pick errors and returns.

There should be agreement at senior levels that any innovative leaps identified are critical to success and must be planned and scheduled properly to optimise ROI and avoid plateauing or future waste.

In developing their optimal plan, organisations can develop a well-defined gap analysis, outlining the incremental improvements and innovative leaps they need to either catch up with global leaders or take the global lead in their industry. The organisation should have confidence that it has the capability to close these gaps as quickly as possible or can engage partners with the required experience.

As part of that approach, meetings and site tours with industry leaders and technology providers can gain awareness of current KPIs that are achievable for key processes within an operation.

Transition planning between technology providers and warehouse managers provides another critical step in ensuring

that no opportunities are missed, and the installation of new solutions can be phased in appropriately.

Every business is striving to improve, but not all improvements are complementary or equal. Opportunities to stay ahead of the competition can be stalled by an organisation's own efforts. Critical to enduring competitiveness are a regularly reviewed strategic approach to improvement, and a long-term strategy to deliver.

The Kaizen Paradox is a common predicament for many businesses, where investments are made to achieve productivity gains, but in doing so they dilute the business case for a better investment, causing them to plateau at a lower level of productivity. Once organisations are aware of the potential for investments that create a Kaizen Paradox, they are better able to consider potential improvements as part of a bigger, longer-term picture.

**Paul Stringleman is a Senior Consultant at Swisslog. He began his career in intralogistics 20 years ago in Tokyo, Japan, and has spent 15 of the last 20 years living abroad and designing large-scale automated systems for airports and distribution centres. In the past five years, Paul has developed several data-driven automated warehouse solutions for e-commerce retail companies in Australia.*

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SOFTWARE FOR AUTOMATED TEST SYSTEMS

NI has announced the release of its InstrumentStudio software for NI PXI modular instruments. InstrumentStudio improves the live, interactive use model for modular instruments and makes debugging while running tests more intuitive. It is designed to help engineers in the aerospace, automotive and semiconductor industries benefit from a more effective workflow for test system development.

The software evolves the concept of single-instrument soft front panels into a unified, multi-instrument environment, so engineers can capture screenshots and measurement results in one view from their suite of instruments. It can also save project-level configurations for specific devices under test that can be repurposed later or shared with colleagues. This efficiency is key for testing high-mix devices and provides test repeatability at a convenience to the engineer or technician.

At different stages in the product design cycle, test engineers often waste valuable time correlating measurements between similar tests that ultimately use different hardware. And in production test, engineers who need to debug on the manufacturing floor may invest in separate hardware either for monitoring their tests or debugging their automated test equipment.

InstrumentStudio addresses these challenges by exporting configuration files to programming environments that reproduce settings, thereby simplifying measurement correlation. Additionally, test engineers can monitor PXI instrument behaviour by running the software while test sequences execute in parallel, streamlining the debug process. Through these seamless interactions with programming environments and test sequences, InstrumentStudio becomes an important part of a comprehensive software workflow and helps engineers maximise their investment in PXI instrumentation.

National Instruments Australia Pty Ltd

www.ni.com

CONTACTLESS VOLTAGE PROBE

The Hioki SP3000-01 contactless voltage probe is suitable for the servicing and investigation of electronics subject to the miniaturisation of devices and use of waterproof connectors, often making it impossible to establish contact with metal terminals. It also avoids the danger associated with static electricity damage to sensitive components when insulation from wires is removed to provide metallic contact.

Measurement of insulated wires with outside diameters ranging from 1 to 2.5 mm is possible, at frequencies of 10 Hz to 100 kHz, and 5 V_{RMS}, 14 V_{P-P} rated measurement voltage. Power supply options are via USB mini receptacle, 5 V ±0.25 VDC or AC adapter (100–240 VAC).

Power Parameters Pty Ltd

www.parameters.com.au



THERMAL DISPERSION FLOW SWITCHES

The Sitron CF Series thermal dispersion flow switches offer a wide range of customisation with alternatives to suit any application. With all 316SS wetted parts, the Sitron thermal dispersion flow switches offer an alternative to mechanical flow switches in applications where build-up, contaminants, flow restrictions or pressure drops may prove troublesome. Sensors may be calibrated for use with liquids or gases with a set point from 3 cm/s to 3 m/s for liquids and 5 cm/s to 5 m/s for gases.

Flanged, threaded or TriClamp (sanitary) process connections are available in a range of sizes, with insertion lengths designed to suit the specific application. Simple inline adjustment of alarm set points is done inside the weather-proof enclosure, constructed from glass-filled nylon, aluminium or stainless steel. Industry-standard female threads and electrical plug alternatives are available for cable connections.

The Sitron CF Series offers different models for DC- and AC-powered sites, with high temperature and remote (DIN rail-mounted) electronics variations to suit each. In harsh or corrosive applications, the sensing probe may be coated in different protective media such as Halar or Epoxy to extend the instrument's life expectancy.

The Sitron range can provide simple, dry contact relay output (1 or 2 SPDT) to allow backward compatibility with process control circuits developed to suit traditional mechanical switches. Local indication is provided on the enclosure during operation.

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The DeFelsko PosiTector 6000 is a ferrous and non-ferrous coating thickness tester with a storage capacity of up to 100,000 readings, available to rent from TechRentals. It supports simple functionality with enhanced one-handed menu navigation, more than 60 readings/min and a flashing display designed for noisy environments.

This unit continually displays and updates average, standard deviation, min/max thickness and the number of readings while measuring. The measurement range is from 0 to 1500 μm or 0 to 60 mils (selectable). Tolerance is $\pm 1 \mu\text{m}$ +1% of reading for 0–50 μm and $\pm 2 \mu\text{m}$ +1% greater than 50 μm .

The PosiTector 6000 has built-in temperature compensation that ensures measurement accuracy. The Hi-Res mode increases displayed resolution for use on applications that require greater precision. This unit conforms to national and international standards including ISO and ASTM. It is supplied with an external probe, calibration standards and a carry pouch.

TechRentals

www.techrentals.com.au

DC UPS WITH NETWORK INTERFACE

The QUINT4 DC UPS uninterruptible power supply is the first QUINT UPS for integration into established industrial networks. It can be integrated into the network easily and flexibly, due to the integrated interface for Profinet, EtherNet/IP, EtherCAT or USB. The device is



available with all network technologies in each of the four performance classes: 5, 10, 20 and 40 A.

The intelligent battery management system with IQ Technology ensures optimum utilisation of the energy storage system. The technology monitors the operating and battery states, such as the remaining life expectancy of the energy storage system and the current state of charge. This makes it possible to plan the battery replacement based on the expected service life in months. The type of battery connected is recognised automatically due to automatic battery recognition. The adjusted charging characteristic maximises the service life of the energy storage system, and the battery charger supports up to 5 A to ensure the fastest possible times for recharging the energy storage system.

A cold-start function starts the power supply even without input voltage. A function test and start-up are thus possible even without a supply network. With SFB Technology, which provides up to six times the nominal current for up to 15 ms, standard miniature circuit breakers are tripped selectively and loads connected in parallel continue working. At widths of between 35 and 47 mm and heights of 130 mm, the uninterruptible power supplies are space saving in the control cabinet.

Phoenix Contact Pty Ltd

www.phoenixcontact.com.au



PROCESS SAFETY VALVES

Gresswell has appointed Tecpro Australia to be the exclusive Australasian distributor of its valves.

Gresswell safety valves are used in diverse applications such as boiler systems, pumps and enclosed pressurised systems as well as in the shipping, oil and gas industries. Made in the UK, the valves are produced in iron, bronze, brass and stainless steel.

All Gresswell safety valves have CAT IV PED certification and CE Mark certification. They are factory tested and supplied preset.

The valves are available in pressure ranges from 0.5 to 20.7 bar and are suitable for most

liquid applications where a small discharge ensures the system's safe pressure is not exceeded. The safety valves are also suitable for steam, gas and vapour applications where a low discharge is suitable.

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Founded in Germany, Hirschmann is currently the only brand on the market to offer homogeneous data communication in the industrial sector using Ethernet and Fieldbus systems including Layer 2 and Layer 3 switches as well as industrial security and WLAN systems.

The entire Hirschmann range is available to order now through Control Logic, Australia's most awarded and trusted product and service providers. With a dedicated team of technical engineers and access to 24-7 support, Control Logic is here to help.

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INDUSTRY 4.0 NEWS CONSORTIUM HOLDS SUCCESSFUL FIRST BREAKFAST EVENT

At a breakfast forum held at the Kooyong Lawn and Tennis Club on 30 May, 60 guests enjoyed a host of speakers and a series of presentations on industrial digitalisation and Industry 4.0.

At the Industry 4.0 News Breakfast Forum, collaborative partners SICK, SEW-EURODRIVE and FESTO led discussions about the concept of industrial digitalisation and highlighted the current and future potential offered by Industry 4.0. The event was an opportunity to hear from industry leaders and learn more about how Industry 4.0 is shaping manufacturing of the future. The forum's purpose was to start a discussion so that more companies can begin to embrace the concept of Industry 4.0.

The networking aspect of the forum helped people share their interpretations and leverage off each other's knowledge.

The event kicked off with a welcome address followed by a line-up of speakers which included three industry experts in the field: Ben Horan from Deakin University, David Chuter from IMCRC (Innovative Manufacturing Cooperative Research Centre) and Dr Nico Adams from Swinburne University. Each speaker provided some great insights on digital advancements which could transform businesses and what funding is available to support these.

Key speakers from SICK, SEW-EURODRIVE and FESTO also shared news about the direction each company is taking moving forward and the opportunities being created through technological developments.

Following the presentations, it was time for a Q&A with panel members Ben Horan, David Chuter and Nico Adams expanding on what was discussed and offering some tips for Industry 4.0 implementation. It was great to see everyone listen in so attentively and engage with one another while enjoying breakfast in the surroundings of the prestigious Kooyong Lawn and Tennis Club.

This was the first event since the collaboration between these three leading automation companies, with more events planned in the future.

Now is the time to make the most of the opportunities presented by Industry 4.0. Digitalisation is a multiyear journey, and it's important to set a clear vision and strategy as well as ask yourself some fundamental questions before you start the process 'What do you want to achieve?'

UPGRADED CHILLED MIRROR HYGROMETERS

Michell Instruments has launched its upgraded S8000 chilled mirror hygrometer range. The first of the new instruments released in April 2018 were the S8000 RS and S8000 Remote. The mid-range S8000 Integrale is to be released in May.

The chilled mirror hygrometers from Michell cover a dewpoint range from -100 to +120°C dp, using both integral and remote sensors. The remote sensors can survive environmental temperatures up to +120°C, so can often be positioned directly at the point of interest.

The upgraded S8000 series instruments now use the same intuitive, touch-screen HMI, making them easier to use and configure. For multi-instrument users, the common interface makes it simple to switch between models. A complete range of communication options is now available on all models, giving the option of USB, Ethernet, RS232 or RS485 making it easier to establish connectivity with other systems. All models feature data logging to SD card as standard for convenient standalone operation.



The instruments use the chilled mirror principle to ensure reliable and drift-free measurements of dewpoint. The S8000 RS offers an accuracy of $\pm 0.1^\circ\text{C}$ dp, which can measure dewpoints down to -90°C with no need for additional cooling. Typical applications range from use as a calibration reference to industrial settings where precise control of humidity is critical.

The S8000 Remote combines high accuracy with a remote sensor for measuring directly in the process. Typical applications include environmental chamber verification, pharmaceutical manufacture or as a NMI-traceable precision reference tool for field calibrations.

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



PRESSURE TRANSMITTERS

The Honeywell SmartLine pressure measurement systems are designed around a high-performance piezoresistive sensor, and since they utilise a modular design, it is easy to replace hardware and indicators, change electronics modules or meter bodies without affecting performance. The transmitter interface has an advanced graphics LCD display, and the transmitters have flexible configuration with no need for a handheld device.

Polarity insensitivity means the SmartLine transmitters can be reversed without damaging or affecting normal operations, and Honeywell's Smart Connection Suite means the transmitters integrate with all control systems. Importantly, all the products and protocols have to been tested and integrate with Honeywell's Experion Process Knowledge System (PKS). The integration to Experion gives operators added benefits such as extended diagnostics, maintenance status displays and transmitter messaging.

The range includes absolute, differential, gauge and remote seal transmitters to flanged (level) and multivariable transmitters as well as remote indicators.

Thermo Fisher Scientific
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INDUSTRIAL CYBERSECURITY SOLUTIONS

Honeywell has announced a software solution to provide cybersecurity to industrial customers who manage diverse process control networks, sites and vendors. As customers continue their digital transformation and their industrial sites become more connected, integrating cybersecurity has become even more critical.

The multisite solution for cybersecurity management is based on Honeywell's ICS Shield, which provides a top-down operational technology (OT) security management solution for securing connected industrial control system (ICS) environments with multiple physical sites and multiple automation equipment types. It also enables secure management of remote field assets through a single security operations centre.

For companies facing internal cybersecurity skills and resource shortages, Honeywell Managed Security Services can help install, configure and continually manage ICS Shield, allowing customers to focus on running their operations. Managed Security Services provides secure remote access, automated patching, continuous monitoring and incident response along with firewall and intrusion detection system management capabilities. These services expedite the ability of industrial companies to close major security gaps, and unlike pure IT solutions, ensure that industrial security experts carefully balance manufacturing and production priorities with security requirements. In addition, knowledge transfer from Honeywell experts improves customers' cybersecurity capabilities in the long term.

Honeywell Process Solutions

www.honeywellprocess.com

PREDICTIVE MAINTENANCE ANALYSIS SOFTWARE

MathWorks has announced Predictive Maintenance Toolbox, designed to help engineers design and test condition monitoring and predictive maintenance algorithms. The product offers capabilities and reference examples for engineers who are designing algorithms to organise data, design condition indicators, monitor machine health and estimate remaining useful life (RUL) to prevent equipment failures.

With Predictive Maintenance Toolbox, engineers can analyse and label sensor data imported from files that are stored locally or on cloud storage. They can also label simulated failure data generated from Simulink models to represent equipment failures.

Signal processing and dynamic modelling methods that build on techniques such as spectral analysis and time series analysis let engineers pre-process data and extract features that can be used to monitor the condition of the machine. Using survival, similarity and trend-based models to predict the RUL helps engineers estimate a machine's time to failure. The toolbox includes reference examples for motors, gearboxes, batteries and other machines that can be re-used for developing custom predictive maintenance and condition monitoring algorithms.

The product allows engineers to develop and validate the algorithms needed to predict when an equipment failure might occur or to detect any underlying anomalies by monitoring sensor data.

MathWorks Australia

www.mathworks.com.au

ETHERNET SWITCHES

Phoenix Contact is extending the range of managed switches in its FL Switch 2000 range with 16-port versions to accommodate the increasing number of Ethernet-capable devices in automation networks.

The flexibility of the wide range of connections with up to four fibre ports, combo ports and various FO connection methods in the SC, ST/BFOC and LC classes will continue to be available in the 16-port versions. In addition, the user can select the appropriate range of functions as well as Gigabit versions for high communication requirements to suit the application.

In addition, the switches support power supply connections with push-in technology, making device installation faster. Automated cabling is also possible.

Phoenix Contact Pty Ltd

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IoT EDGE GATEWAY IPC

Modern system concepts tailored to Industry 4.0 or the Internet of Things (IoT) offer numerous advantages in terms of process efficiency and quality. The compact C6015 industrial PC (IPC) is a space-saving, high-performance IoT edge device that fully utilises these advantages for new and legacy systems in the process industries.

By integrating comprehensive IoT and analytics functionality, PC-based control technology opens up a large range of options to optimise production. System consistency in the control platform ensures simple implementation and high transparency:

Measuring 82 x 82 x 40 mm, the C6015 IPC with multicore technology can be flexibly installed in highly confined spaces. Equipped with an Intel Atom processor offering up to four CPU cores, the product provides sufficient processing power for simple collection, processing and provision of process data and for the more complex tasks required of a modern IoT gateway. Microsoft Azure certification underscores that the device is suitable for state-of-the-art Industry 4.0 applications.

Existing process technology systems can be easily equipped with additional IoT capabilities using the IoT edge device or they can be readied to meet future communication requirements. In this way, operators of process technology systems gain access to IoT and analytics solutions supported by Beckhoff technology, regardless of the automation technology used — be it PC-based control or third-party control platforms. This reduces production costs, optimises product quality and improves the overview and transparency of all process workflows.

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MAXIMISING MONITORING

THREE KEY WAYS TO IMPROVE PROFITABILITY

Clinton Hommel, Product Marketing Specialist, Phoenix Contact USA

Energy monitoring is generally sold as a money-saving technology, but when properly utilised it can provide insights to improve a plant's overall efficiency in other areas.

Smart instrumentation, monitoring and the connected factory represent an exciting new era in industrial automation known as the Industrial Internet of Things (IIoT). The IIoT is transforming the way we design and operate all kinds of equipment. It even influences plant design as a whole. The promises of smart factories that can reduce energy consumption and boost uptime are firmly rooted in monitoring and collecting data on equipment of all types.

The emphasis on monitoring within the IIoT is by design, as monitoring is one of the single-best mechanisms for improving operational efficiencies. It is not uncommon for energy monitoring to be overlooked as nothing more than an energy-efficiency product. Energy savings are great, with benefits for the wallet and the planet alike, but looking at energy monitoring only as a tool to reduce consumption leaves a lot of additional cost-saving opportunities on the table. Simply put, monitoring enables operational improvements from a number of angles.

The goals of this article are to introduce the three basic ways monitoring can help achieve savings. It will conclude with some insight on system scaling and a few applications.

Meet RAE

There are three major ways that energy monitoring can improve profitability: RAE (reliability, accountability and efficiency).

Though all three concepts are related, they each have unique benefits and cost-saving mechanisms. Taking advantage of RAE as a whole substantially increases the return on investment (ROI) in monitoring equipment, especially when compared to implementing energy-efficiency improvements alone.

Reliability

The single-most important benefit of energy monitoring in the industrial world is not energy savings, but rather, uptime and reliability improvement. Energy signatures and power quality within systems play large roles in unlocking predictive maintenance, also known as just-in-time maintenance (JITm). Unlike run-to-fail or preventive maintenance programs, downtime or excessive spending on interval-based equipment replacement can be minimised or avoided altogether.

JITm at its core involves monitoring energy usage, utilisation and quality, comparing it to historical baselines, and then flagging anomalies as action items to investigate before a failure occurs. These types of anomalies can be the result of typical wear and



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tear, the need for periodic maintenance or equipment end-of-life, to name a few. Monitoring can also be used to detect other conditions that would require regular maintenance typically associated with a certain amount of runtime. By accurately detecting things like tooling wear, filter contamination or consumable materials depletion, maintenance personnel can schedule time windows to optimally balance maintenance needs with production uptime.

Accountability

There are also some benefits to maintaining monitoring and logging equipment that are independent of utility metering. Operating energy meters independent of the utility allows facility managers to verify billed energy quantities, as well as time-of-day and usage rate data. It also allows them to have logs of all of this data and the quality of service delivered. Logs and independent data points can be a significant help in cases of utility failures or billing disputes. These logs are frequently used to hold utilities accountable for remediation if a customer is overcharged or if there is a utility-side issue that results in damage to equipment or lost production time.

A significant side benefit of maintaining logs is the ability to conduct a more thorough failure analysis in the event of sudden

failures. These types of failures are different than those prevented by JITm because they typically occur as a result of issues with the quality of the power delivered and are not a function of machine wear. Much like IT departments use event logs to determine what was happening before, during and after an unexpected outage, maintenance departments can use energy logs as tools to assess power system conditions surrounding a failure. This may reveal a root cause or it could expose equipment vulnerability issues. Accordingly, the maintenance personnel can take necessary corrective actions to avoid future downtime.

Efficiency

Efficiency, specifically energy efficiency, is often seen as savings through reduced consumption by switching to high efficiency electrical devices — think NEMA premium efficiency motors and transformers or LED lighting upgrades, for example. While these types of upgrades do indeed improve efficiency, overall efficiency improvement is a broad topic that also includes the often overlooked element of optimisation.

Efficiency optimisation involves correcting inefficiencies in processes and machine cycles alike. Some of these inefficiencies are the result of machine malfunction and other inefficiencies are present simply because certain machines or processes have never been optimised. The most common types of inefficiencies would primarily include wasteful machine cycles, equipment failures resulting in excessive energy consumption and parasitic loads.

Monitoring plays a critical role in optimisation by providing a clear picture of how much energy is used and how it is being used. Data collected by monitoring is compared to historical consumption, utilisation and machine throughput trends. Once usage baselines are established and performance metrics are defined, undesirable conditions can be identified and eliminated.

Data is king, but only if it's used

Broadly speaking, there are three sets of monitoring data that can be analysed to achieve all of the benefits of RAE — instantaneous data, current versus historic data and logged data. Each has its own place in the toolbox of process optimisation, and each one can vary in both the story it tells and the complexity of that story. There is an entire industry dedicated to the analytics of these datasets, because the knowledge gleaned is very powerful, and sometimes very specialised. While some of the upper echelons of monitoring benefits can only be realised by using powerful software algorithms catered to a specific industry or application, the basic benefits of RAE are easily attained using some simple intuition and a basic controller or data logger.

While a statistical or calculus-based approach can predict failures and action items with a high level of precision, there is a trade-off between the costs of such services and the realised savings of know-



MANY ORGANISATIONS INVEST IN MONITORING EQUIPMENT BUT THEN FAIL TO FOLLOW THROUGH ON ANALYSING THE DATA IT RETURNS.



ing precisely when something will fail. Those types of services and platforms are beyond the scope of this article, but their importance should not be discounted, especially for mission-critical applications.

Measured energy parameters as tools of insight

Each point of measurement provides a unique insight into system or machine health. By applying some critical analysis to the data that is measured, RAE becomes easily achievable. Key parameters — such as voltage, current, power, energy, power factor and harmonics — can tell the system's story.

A word on scale

Scaling a system to the user's needs and goals is a form of efficiency in itself. To avoid excessive spending and poor ROI, it is necessary to scale the capabilities of the monitoring devices to the needs of the machine or process. It is also necessary to consider the overall impact of any one particular component on uptime. While some motors or heater elements may be redundant within a process, others may represent a critical failure point — the appropriate amount of monitoring, analytics and maintenance should be prescribed accordingly.

For example, downtime of a simple conveyer belt application might not greatly impact overall production because it can be bypassed by manual labour. Spending thousands of dollars on a dedicated energy meter might not make financial sense when a \$100 voltage monitoring relay suffices to protect the motor.

Conversely, the intake pumps at a wastewater treatment facility are considered mission-critical to the operation of the plant. Should one of the pumps fail unexpectedly, water treatment could be adversely impacted. The motor may cost \$10,000 and it could be connected to a pump that costs tens of thousands of dollars. It is fairly obvious that the water treatment plant operator would want to know everything they can about the pump's state of health so that they can plan maintenance as needed, so that they have an advanced warning before any failures should occur, and so that they can protect their investment in the pump itself. Run-to-fail is simply not an option in this application. As another cost-saving benefit, once monitoring is incorporated, it can also be used to switch the pumping station to an as-needed maintenance schedule instead of a periodic routine maintenance plan. Such plans typically involve rebuilding or replacement of critical components on a fixed schedule regardless of equipment health.

Selecting monitoring equipment without overspending or underspecifying can be done by calculating how often a failure occurs,

how much the downtime costs you and then comparing it to the cost of the monitoring device. For lower-end devices such as voltage/phase monitoring relays and basic current transducers, monitoring almost always pays for itself on the first outage it prevents. More advanced platforms that incorporate energy meters, power quality meters and analytics can cost well over \$10,000. Such a solution is not fitting for every application, and it might not ever pay for itself if it is inappropriately applied. There are, however, processes where just one outage prevention would pay for the system several times over. It can often be tricky to strike the perfect cost-benefit ratio no matter the investment, but having specific needs and goals in mind can help ground the selection of monitoring equipment in reality.

Conclusion

The decision to invest in energy-monitoring technology is often grounded in the somewhat vague promises of what the IIoT will bring to the modern plant and its bottom line. Energy monitoring is generally sold as a money-saving technology, marketed as devices or platforms that can help users reduce energy consumption or costs. However, some issues continue to plague the industry in its quest to unlock the promised savings.

Many organisations invest in monitoring equipment but then fail to follow through on analysing the data it returns. This reduces the equipment's ROI, and it greatly limits the realisation of the promised benefits. It is an issue that stems from the fact that, in many cases, little is done to help customers, operators and engineers realise the benefits of monitoring once the systems are in place and the integrators have gone home.

However, engineers and operators shouldn't settle for underperforming or underutilised monitoring systems. By applying the RAE principles and implementing a JITm program, those promised benefits can be suddenly realised, and an exciting new reality — one filled with uptime and cost savings — displaces the underwhelming realities of systems that do not make use of the data they collect.

Ultimately, when care is taken to properly implement monitoring, it can significantly reduce operational costs. It results in a better bottom line for everyone — maintenance costs and utility bills are reduced, uptime is improved and profitability is enhanced. To paraphrase Benjamin Franklin, where there is money to be saved, there is money to be made.

Phoenix Contact Pty Ltd
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COMPACT ANALYTICAL TRANSMITTER

Endress+Hauser has launched the Liquiline Compact CM82

multiparameter analytical transmitter. Its housing measures 11 cm long

and 2 cm wide and therefore fits, together with the sensor, into almost every assembly.

The Liquiline Compact can be operated and configured via Bluetooth using the SmartBlue app. Using the app, users see all the measuring points within the Bluetooth range of their tablet or smartphone. The Bluetooth connection is protected with the same technology that guards German identity cards against unauthorised access by third parties and was also confirmed by the German Fraunhofer Institute for Applied and Integrated Security (AISEC).

The product is compatible with all transmitters, analysers and samplers from Endress+Hauser's Liquiline platform. Connectable to the CM82 are pH, ORP, conductivity, oxygen and chlorine sensors with the blue Memosens plug-in head. The Memosens technology ensures 100% data transmission and true plug and play with precalibrated sensors.

As a loop-powered, two-wire device, the product can be connected directly to a PLC, which also serves as the power supply, thus eliminating the need for a power cable. A cable for the sensor connection is also not necessary, since the sensor is plugged directly into the transmitter.

All settings are saved in the device — the transmitter reads all sensor and calibration data stored in the head of a Memosens sensor. In the case of a sensor exchange, the sensor is automatically detected within seconds and the measurement is immediately ready for use after a sensor change.

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TR2022



TRACE MOISTURE ANALYSER

Michell Instruments has announced the launch of its recently enhanced QMA401 low-maintenance trace moisture analyser.

Maintaining this updated quartz-crystal oscillator based analyser is simple, infrequent and inexpensive. No service at all is required for at least two years, at which point the desiccant dryer could need replacement — a process that can be carried out by the user in less than 10 min.

It is straightforward to replace

the internal moisture generator in the field with a freshly calibrated NPL or NIST traceable reference unit from the factory, which will last for a full three years of operation.

The quartz crystal technology-based hygrometer features an improved touchscreen interface. The menu system is intuitive for easy operation following the structure known from Michell's range of chilled mirror hygrometers. Operators and service engineers will be able to switch easily between the S8000 chilled mirror range and the QMA401. The case of the QMA401 has also been redesigned with a modern, easy-clean surface, which is similar in look and feel to the S8000 precision hygrometers.

Using the new generation of quartz crystal microbalance (QCM) sensor, the QMA401 precision hygrometer provides consistently accurate measurements of trace moisture. This is achieved through an automatic self-calibration system that adjusts the analyser against an internal moisture generator (traceable to NPL and NIST).

AMS Instrumentation & Calibration Pty Ltd

www.ams-ic.com.au

HIGH-OUTPUT, INTRINSICALLY SAFE SIGNALLING

NHP has announced a range of low-power, high-output, intrinsically safe signalling products from Moflash that can be paired with the corresponding intrinsically safe barrier from GM International to create an easy, off-the-shelf kit solution for IS signalling needs.

The Moflash range consists of a 24 VDC sounder with a 105 dB output, a 24 VDC beacon, nine bright LEDs for high visual output, and a sounder/beacon combination unit. These devices are suitable for all hazardous environments and come with Group I certification for use in underground mining.

Available in a range of colours, the solution is rated for hazardous zones 0, 1, 2, 20, 21 and 22 in IIC (gas) and IIIC (dust) environments. In addition, they are T5 and T6 temperature rated, making them a suitable alternative to their heavy-duty Ex d flameproof counterparts.

NHP Electrical Engineering Products Pty Ltd

www.nhp.com.au



PRESSURE GAUGE WITH AUTO CALIBRATION REMINDER

Crystal Engineering, a unit of AMETEK Sensors, Test & Calibration, has added an automatic calibration reminder system to its XP2i pressure gauge. The system reduces the possibility of using gauges after their calibration dates and potentially incurring regulatory fines.

Manual record keeping and notifications are replaced by customisable on-screen alerts prior to the due date, warning alerts



on and after the due date, and an optional capability to lock the gauge from use after its calibration due date. Dates, reminders and message types are set by supervisors through free software.

Because they measure critical performance metrics of a wide range of equipment, properly calibrated pressure gauges can be important factors in worker safety, pollution control or product quality.

The rugged, intrinsically safe gauge offers pressure recording in harsh environments. Key features include an IP67 rated, marine-grade enclosure; a fast pressure safety valve (PSV) mode; custom engineering units; and a leak-free pressure fitting connection.

Active digital temperature compensation corrects the sensor for changes in temperature. It is guaranteed to 0.1% of reading accuracy from -10 to 50°C. Every XP2i comes with an ISO 17025 calibration report — NIST traceable, A2LA accredited — with test data at five temperatures. Its high-contrast liquid-crystal display is readable in all conditions from bright sunlight to dark (with included backlight).

AMETEK Sensors, Test & Calibration

www.ametekcalibration.com

WHEN I GROW UP, I WANT TO BE A SENSE MAKER

Ask a five-year-old what they want to be when they grow up. Chances are 'machine learning specialist' will not rise to the top of the list. For decades, our show-and-tells have been catwalks for classic capitalism, where mini pilots and policemen strut their oversized uniforms for kindergarten audiences. We're very comfortable with our kids wanting a career as a doctor or a lawyer when they grow up; we may even entertain the idea of builder or architect for some years. But, at the end of the day, when university fees are all paid up, we're still pulling our old-school paradigms, like a hood, over our eyes and expecting our kids to have the same jobs that we've had.

Here's some news for you, Mum and Dad. Little Joanne may have to change her career path.

The digital age is accelerating at a magnificent rate and re-writing business as we know it. It's not hard to be daunted by it all — especially if your job is all about replicating a task at hand. Somewhere in a back room in Hyderabad, we've all been warned, hundreds of over-caFFEinated techies are working around the clock to empower technology to outwit, and eventually replace, our human faculties.

Going, going, almost gone are the jobs we esteemed the stuff of heroes. But, if robots will soon be putting out fires and transplanting hearts better than people, we've got to ask, *what on earth should we be doing? If being a hero is about helping others, who will be the future's new heroes?*

"Is it a bird, is it a plane?
No, it's tomorrow's Super Sense Maker!"

Sense makers are the problem solvers of the business world — the creatives and critics who are not afraid to try and fail at offering brave new solutions. They could be artists, consultants, design thinkers — builders of our digital world. Sense makers are loaded with filters to sift through the ever-increasing volume of information so that a story, deeply human, keeps rising to the fore.

More than just 'getting a job', our message needs to be *what do you think and how will you make sense of it all?*

Humans still do human better

The ability to listen and engage, to mobilise a common vision, and to springboard instinct into action is deeply intuitive and deeply human. That's because it's not so much about mastering tech as it is about working with people. And, according to McKinsey in its 2016 Quarterly Report, these are the kind of jobs that won't go out of style, even when the robots come to town. Activities that involve managing and developing people make up the lowest category of vulnerability (at 9% automation potential), while knowledge work that involves decision-making, planning or creativity comes in at 18%. This kind of creative work could be anything from project consulting to dreaming up menus for the new vegan restaurant in town.

So, although computers win out when it comes to executing very well-defined activities, the fact is humans are still better

at being human. They drive original processes with perceptivity, intuition and occasional bursts of genius. The power of the human imagination is still a force to be reckoned with, because it synthesises simultaneous and highly complex levels of human processing into one neurological response. Emotion, reason and adaptability, instinct and discernment have a role to play in influencing extraordinarily unique outcomes in ways that computers still fail to do.

The new job gap

"Don't believe the hype," says Forrester Consulting, in their 2016 report on *The Future of White-Collar Work: Sharing Your Cubicle with Robots*, "Google AlphaGo's gaming successes and IBM Watson will not usher in a dystopian triumph of machines over humans." Instead, they suggest, it will be more a case of kumbaya between man and machine. Although the report predicts 16% of US jobs will be replaced, it also says we're going to invent 9% new jobs to make sense of all these new digital tools.

In fact, by 2025, a batch of 8.9 million new jobs is predicted to be served up in the US alone: jobs like data scientists, automation specialists and content curators. Consultants will especially be needed to unpack this new paradigm and bridge digital divides in the workplace: such a pivotal role that consultancy is expected to grow 10% by 2025.

The power of human connections

While computer programming may become a bad career choice for the future (should a joint initiative

between Microsoft and Cambridge University successfully manage to teach computers how to write their own code), there is good news for the sense makers among them. Knowing which robot to use, which digital platform to apply among the many will be critical as technology sophisticates. Or knowing which drone and which spatial data technology to choose among the breathtaking range of digital recreations.

No longer in the back rooms, consultants, project managers and even artists will be needed to blend the machine coded elements on the master canvas in order to solve the client's problem logically and in a way that 'feels right'.

Expert advisory isn't just about mastering the technology; it's about being able to eyeball your clients, ask questions, understand their needs and build trust over time. Who knows? Maybe in time robots will give Dr Phil a run for his money. But for now, we can breathe a sigh of relief. Those who master a mix of problem solving, emotional intelligence and creativity will stay in the game.

As opposed to 6-figure stability, agility is now the coveted mark of a successful leader. Tomorrow's story will be steered by those who are willing to see the gaps. It's time we open up our show-and-tell catwalks and strut some deep learning.

This article was first published by Mike Pinkerton on Aurecon's Just Imagine blog.





PLC MIGRATION TOOL

Honeywell Process Solutions has announced ControlEdge Transition, a tool that makes it easy to migrate obsolete, risk-prone PLCs to Honeywell ControlEdge PLCs. This transforms them from liabilities into productive assets that can enhance process uptime and strengthen the security of an industrial site.

If not addressed, outdated PLCs can lead to increased cyber-security risk or even trigger unplanned site shutdowns. Through a fast, automated conversion process, ControlEdge Transition supports upgrades to Honeywell ControlEdge PLCs, which can then be integrated into a SCADA or DCS system. Additionally, the speed and efficiency of the conversion procedure saves systems integrators and project engineers significant time, cost and risk compared to a manual migration effort.

ControlEdge Transition can be deployed over mobile devices to survey and document the number of obsolete PLCs at a site while capturing relevant data that can be used for accurate up-

grade planning. The tool's bidding and engineering reporting capabilities can simplify the development of proposals and reduce engineering effort by up to 50%. In addition, pre- and post-migration reports provide extensive support for design, installation and commissioning of new PLCs.

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**NEW
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AUTOMATION CONTROLLERS

Omron Electronics has announced the NX1 series of industrial automation controllers. Based on, and compatible with, Omron's SYSMAC platform, the NX1 series has attained OPC UA certification, meaning OPC UA server functionality is now standard across the series.

The OPC standard was established over 20 years ago and has proved highly effective in providing interoperability for both horizontal (M2M) and vertical (supervisory system) connectivity. It was further enhanced in 2008 when OPC UA (IEC 62541) was released. Unified architecture means any computer platform or operating system can use OPC UA. X.509 authentication and data encryption were embedded, which are fundamental for secure, cyber-based IIoT connections.

The NX1 series utilise the IEC 61131-3 PLC programming standard, PLCopen function blocks and safety programming. It supports up to 12 servo control axes and allows up to 32 NX slice units to be mounted on the CPU. Dual EtherNet/IP and EtherCAT ports are provided on all NX1 CPUs, which also natively supports other protocols such as Modbus/TCP and FINS for existing installations.

Omron Electronics Pty Ltd
www.omron.com.au

PRESSURE TRANSDUCER AND PUMP

The Fluke 70 bar pressure transducer has a range of 0–70 bar, a resolution of 7 mbar and reference uncertainty of 0.025%. Included with this transducer is a 700PTP-1 pressure pump that operates to 41 bar. This gauge pressure module measures pressure with respect to atmospheric pressure.

To measure pressure, users connect the pressure module to a pressure source or hand pump and then connect the pressure module cable to the calibrator. Pressure applied from the pressure source will be displayed digitally on the calibrator. At the touch of a button, the pressure may be displayed in up to 11 different engineering units.

This NATA certified pneumatic transducer and pump system is suitable for use with the Fluke 700 series of pressure, documenting and process calibrators. The 725, 726 and 754 are among the compatible Fluke instruments which are also available for rent from TechRentals.

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HOW ZOOMORPHISM CAN TEACH US TO MAKE BETTER ROBOTS

MAKING MORE NATURAL ROBOTS MAY BE THE ANSWER TO INDUSTRIAL WOES.

Jonathan Wilkins, Marketing Director, EU Automation

People were touched when the groundbreaking BBC documentary, *Spy in the Wild*, broadcast a group of Indian langur monkeys mourning the apparent death of a baby robot monkey that they had accepted into their group. The robot monkey was filming the goings-on of the group when it fell from a height and was taken out of action. As it lay still, a hush spread through the group and, one by one, the monkeys began to hug and console each other in a show of grief.

This is a touching story that helped scientists learn about group behaviour in a new and novel way, and it also demonstrates how engineers can create a robot so natural in its movements and mannerisms that a group of relatively intelligent animals could not tell it apart from their own.

While humans are yet to overcome the same uncanny valley for human androids, there is a lot we can learn from the development of robots that exhibit animal characteristics. Three areas that are particularly interesting are grippers, limbs and artificial intelligence software.

Grippers

One of the biggest barriers to the adoption of industrial robots in picking and packing lines has been the use of adequate grippers that can pick objects of varying size, shape and weight quickly and accurately without damaging or deforming the product. This is especially important in the food and beverage sector, such as supermarket fulfilment centres, where soft hand-like grippers with fingers covered in tiny suckers are used to pick and pack items of food such as heads of lettuce without damaging the product.

At the same time, the grippers must be durable enough to handle glass bottles and heavier metal cans of soup continuously.

Limbs

Although there is a tendency to create robots after our own image, why create robots with human limitations? Modelling the limb movements of robots after those of arthropods, insects and four-legged mammals, such as dogs and cheetahs, offers engineers the



ability to create robots that can traverse rough terrain quickly and efficiently, recovering more easily from falls and setbacks.

While this is particularly useful for military applications, it also offers opportunities for industrial use in factories and plants where such robots could provide use in a more diverse range of applications, replacing the need for single-use robots such as automated guided vehicles (AGVs), cranes and forklifts.

Software and AI

Creating hardware that is capable of mimicking animal movements is only half the battle. Creating the software and algorithms that can mimic the subtle nuances of human and animal interaction is another.

Michael Mendelson, a curriculum developer at the NVIDIA Deep Learning Institute, was quoted in Autodesk's *Redshift* publication explaining that, "Without flexible algorithms, computers can only do what we tell them. Many tasks, especially those involving perception, can't be translated into rule-based instructions. In a manufacturing context, some of the more immediately interesting applications will involve perception."

Although high-resolution machine vision optical sensors exist already, making sense of the high volumes of data in fractions of a second will continue to improve areas such as quality control. Imagine a robot capable of seeing microscopic defects in a circuit board or a collaborative robot (cobot) that can stop an accident when working alongside a human being, by catching a falling object or swerving to avoid a collision without having to bring the factory to a halt.

There are already companies leading the way in zoomorphism-based research and development. Companies such as German automation giant Festo and US robotics expert Boston Dynamics are already pushing the boundaries of what robots can do, having developed examples of birds, sea creatures and mammals in robot form.

By learning the right lessons and embracing what the natural world offers, engineers can go beyond the ordinary and create robots that illicit a truly emotional response.

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The entire drive mechanism works without a single drop of oil, producing oil-free class 0 compressed air. The technology is particularly wear-free and low-maintenance — there is no requirement for regular oil and filter changes. With its compact design, the Low Pressure Turbo 150 requires less space than comparable screw compressors. Turbo technology is also considerably quieter than oil-free screw compressors.

With its continuous improvement programme (CIP), Boge is offering users of the Low Pressure Turbo 150 highly efficient production in terms of energy at all times. The company analyses the machine data in use by the customer and identifies energy-saving potential. On this basis, BOGE continuously develops turbo technology hardware and software that is functionally relevant individually to the customer.

Boge Compressors Ltd

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Iconic Australian biscuit maker upgrades Adelaide production plant

Arnott's is one of the largest food companies in the Asia-Pacific region, employing more than 50,000 Australians over the past century. Today, Arnott's employs around 2200 Australians across all states and territories. The company also employs several thousand people across the Asia-Pacific region, in countries such as New Zealand, Indonesia, Malaysia, Singapore and Japan.

Millions of Australians have grown up with Arnott's over the past 152 years. For them, Arnott's is more than a food company — it's a piece of Australia's history and a national icon. Arnott's portfolio of brands includes household names like Tim Tam, Shapes, Iced VoVo, SAO, Vita-Weat, Salada and Tiny Teddy.

Arnott's produces a wide variety of sweet and savoury biscuits that have been enjoyed by generations. The company's manufacturing plant in Adelaide produces approximately 10,000 tonnes of biscuits annually. To meet increasing local and global consumer demand, Arnott's recently embarked on Project FLEX — a control and HMI system upgrade to deliver increased flexibility and agility for biscuit production.

When embarking on Project FLEX, Arnott's called upon longstanding automation and control provider SAGE Automation. According to Stuart Mitchell, Senior Systems Engineer at SAGE, "We have been working with Arnott's in Adelaide for the past 20 years so we are very familiar with the plant. It is a Rockwell Automation site through and through, so we naturally called on them to help with the upgrade."

With expansion into international markets and a subsequent demand to increase production, it was important for Arnott's to have the ability to run any biscuit on any line while maintaining product consistency.

The first stage of the project involved updating the legacy oven conveyor's PLC hardware to improve the way that operators could load new production orders, including a feature that allows different recipes to be stored, selected and produced on the same line. It also involved the installation of two new cooling systems for conveyors including reprogramming of the control system and HMI.

The control system upgrade required the migration of legacy SLC controllers to Allen-Bradley ControlLogix to help reduce maintenance costs and allow for increased flexibility on production lines; therefore, a staged migration to the new controllers was required. The ControlLogix control system offers modular architectures and a range of I/O and network options. To help reduce engineering time, SAGE used existing SLC I/O in the first stage and subsequently added some Ethernet Point I/O and Flex I/O on DeviceNet. The RSLogix Project Migrator tool was used to install the ControlLogix controllers.



"While the majority of the plant uses Ethernet, there is still some equipment communicating through DeviceNet and DH+, so by using ControlLogix, any potential integration issues were overcome because the controller is compatible with all three networks," explained Jonathan Footman, Solutions Architect at Rockwell Automation. "This flexibility allowed the upgrade to be performed in a staged manner as opposed to having to perform the whole upgrade in one go."

Arnott's also installed seven new PowerFlex 525 drives as part of the upgrade. SAGE was responsible for the drive integration using existing code to both new and existing Ethernet and DeviceNet networks. Moving to the newer platform increased the operational efficiency and centralised the plant's control system.

In addition, Arnott's leveraged the intelligence of the PowerFlex variable speed drives to help operators access real-time information in the plant. "Prior to the drive upgrade, the operators would have to run feedback using analog set points, which was very time-consuming, but now with the PowerFlex drives on Ethernet, all the diagnostics can be accessed in real time," explained Mitchell.

The HMI design and functionality was also updated according to Arnott's specifications to improve the way operators could load new production orders. SAGE designed, programmed and installed the HMI solution allowing for a large number of recipes to be created and stored for each oven. The new HMI system utilises PanelView terminals and reduces the number of pages from approximately 70 to 20, simplifying events with each conveyor having its own pop-up with manual controls and speed settings.

Arnott's is now able to achieve greater flexibility on each line with a reduced margin for human error. According to Andre Spoor, Engineering Manager, Arnott's Biscuits, "SAGE upgraded our PLC and HMI with no loss in production and no downtime. It's a great result for us considering it was such a big upgrade."

"The change has ensured that the site improves its ability to be flexible. It has simplified the selection and set-up process and therefore reduced operator error and provided control systems for the site's conveyors and cooling systems that are well supported within industry."

Thanks to the upgrade, Arnott's is well positioned to meet the growing demand for increased flexibility and agility in its manufacturing operations. By increasing connectivity across the plant floor, the company is realising the benefits of smart manufacturing and is now able to build on this foundation.

Rockwell Automation Australia
www.rockwellautomation.com.au



UPDATED FLOW METER VERIFICATION

Emerson has launched the latest version of its Smart Meter Verification software for Coriolis and magnetic flow meters, providing flow meter verification on demand.

Updated tools in the Smart Meter Verification software allow users to fine-tune and adjust their engineering processes to ensure absolute measurement confidence and top performance in the chemicals, food and beverage, life sciences, oil and gas, and other process industries. In addition to onboard diagnostics, Smart Meter Verification also accelerates implementation of companies' IIoT strategies with its remote diagnostics, digital intelligence and multiple data points, providing users with a complete process overview and greater operational certainty. Rather than time-consuming calibrations and laboratory testing, leading to production interruptions, shutdowns and safety concerns, Smart Meter Verification provides in situ calibration verification on demand without any impact on process or meter outputs. The system also provides operators with crucial information on other flow issues across the plant.

Key features include algorithms that detect coating, corrosion and erosion in the meter; process diagnostic capabilities that include a 'flow range' diagnostic, which alerts the engineer when flow rates are not within the specified range of the meter; instrument diagnostics that can identify if entrained gas is in the process; and immediate alerts to process upsets that may affect measurement performance.

The system also provides clear and transparent verification audit trails, and advanced visual analysis and reporting software that meets third-party regulatory agency compliance requirements in lieu of meter calibration, inspection or removal.

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TAKING A HOLISTIC APPROACH TO CYBERSECURITY ACROSS OT AND IT

As cybercriminals become more sophisticated, it's no longer a matter of if an organisation will be attacked, but when. Although most businesses have taken steps to protect themselves from external, internet-based attacks, many have ignored the risks presented by internal technology. Weak links including critical SCADA and ICS present new and attractive ways for cybercriminals to access an organisation's most critical systems used for producing goods or providing critical industrial services.

Previously air-gapped, these systems are increasingly connected to adjacent business and third-party networks, sometimes via the internet, creating new entry points into the organisation's entire network. Hackers gaining entry this way can compromise the systems directly or can expand further into the network to steal data or sabotage operations.

There are five key ways engineers can contribute to improved cybersecurity in an age of constant breach potential.

1. Work together to identify and address weak points

The new levels of connectivity applied to OT mean all team members need to thoroughly understand the risks posed by OT and ensure these systems are secured with the same vigilance that's applied to IT systems. Whether this imperative is driven by the engineering team or the IT team, leaving OT systems exposed is no longer an option, so teams need to discuss how the organisation plans to secure OT.

2. Share intelligence

Being a good corporate citizen includes helping other businesses protect themselves against cybercriminals. Helping each other can deliver a kind of herd immunity. Sharing threat intelligence and learning from each other is just common sense.

At the same time, it's important to work closely with corporate IT teams, who can help with increased visibility across the corporate network. Working together, the OT and IT teams can uncover any best practice approaches that will help improve the overall security posture of the organisation.

3. Consider automation

Cyber-physical attacks are increasing and even ransomware can be dangerous in industrial environments. Last year's WannaCry ransomware caused downtime in some manufacturing plants, leading to lost productivity. This could potentially have been avoided using ICS-specific automated threat response (ATR) technologies.

ATR technologies take a predefined action to contain or prevent attacks identified by behavioural analytics and artificial intelligence. The goal is to automate the process of detection and implement an equally automated and closed-loop process of prevention. This not only reduces the burden on security teams but also shortens the response time.

Full automation may not yet be possible in OT environments where the risk of causing downtime or safety issues means manual intervention may still be required. However, in some circumstances, automation can dramatically improve protection. For example, if an automated system detects unusual commands from a pre-existing host, it can automatically limit its access until a security team member can investigate the activity.



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4. Improve employee engagement and awareness

Security starts with every employee, so it's crucial to ensure all team members are aware of their responsibilities and the risks they face. This must include developing and communicating clear security policies that people understand and can comply with. Education must be ongoing, with frequent reminders and even drills to keep security top of mind for all employees. Since human error is often at the root of successful cyber attacks, it stands to reason that arming team members with strong security knowledge and processes can dramatically reduce this risk.

5. Unifying the security platform between IT and OT

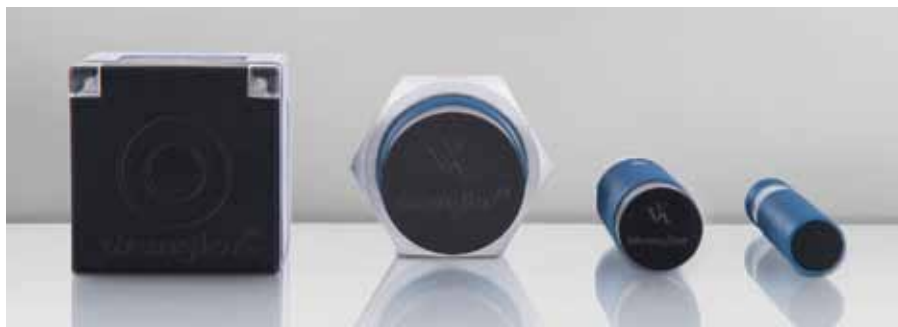
Instead of trying to utilise different firewall products across IT, OT and industrial cloud, organisations should consider adopting a common and flexible firewall technology that can be applied across the entire enterprise from environmentally harsh/controlled industrial automation networks, virtualised public and private clouds for OT, and corporate IT. When security is centrally managed, the security team can see the entire attack surface of a business, providing greater knowledge about potential risk exposure. In addition, OPEX costs can also be dramatically reduced when security teams only have to learn and deal with one technology and approach.

Organisations must also constantly look for ways to further improve their IT and OT security. This includes measures like taking advantage of a contextual threat intelligence service, which helps automate the response process, making it faster and more effective without requiring additional security measures.

It is important to see cybersecurity as a shared responsibility with every member of the team playing a role in keeping the business safe. Many of the systems that engineers have long considered impervious to hackers may now be vulnerable, so it's crucial to understand where the vulnerabilities lie and how to protect them.

**Del Rodillas is the Global Director of Industrial Cybersecurity for Palo Alto Networks where he looks at automation systems through the lens of cybersecurity. He helps global asset owners across critical infrastructure sectors understand cybersecurity best practices and technologies in order to prevent successful cyber attacks while keeping uptime and safety high.*





INDUCTIVE SENSORS

The latest inductive sensors from Wenglor with correction factor 1 offer switching distances of up to 50 mm and a magnetic field resistance of 200 mT. Eight welding field-resistant models with four housing designs are available for the detection of ferrous and non-ferrous metals such as copper, cobalt, nickel and tin.

The sensors always have the same switching distance, even for different metals. A Teflon coating increases availability, especially when used in welding equipment where deposits resulting from welding spatter often have a negative effect on sensor performance. The extended temperature range of -40 to +80°C also permits use in harsh environments.

They are also resistant to DC and AC electromagnetic fields with strengths of up to 200 mT. High switching frequencies of 1500 to 4200 Hz permit use in high-speed applications. All four housing designs (M12, M18, M30 and 40 x 40 mm) are available as flush and non-flush mounting variants. The switching status LED is additionally equipped with an error indicator which is activated in the event of a short circuit or excessive temperature.

Treotham Automation Pty Ltd

www.treotham.com.au

BRUSHLESS DC FLAT MOTORS FOR ROBOTIC JOINTS

The latest frameless brushless DC motor (BLDC) from maxon motor Australia has a diameter of 45 mm, an assembled depth of 23.7 mm and a continuous rating of 50 W. 70 and 130 W versions are also available. The frameless design is particularly suitable for processing machine or rotary stage manufacturers that need a large through bore to pass cabling or tubing. They also meet the increasing need for smaller robotic actuation by making it possible to assemble individual parts directly into a robotic joint.

For positioning, a high-resolution magnetic encoder ring with the same bore as the motor rotor is supplied. The encoder ring is marked with the zero position to allow alignment with the motor zero commutation point in the application and is available in IP-rated, absolute and incremental options.

The combination gives a low-profile, large-bore positioning system made up from standard parts with shorter lead times than specialty manufactured complete assemblies, according to the company. It is suitable for space saving in applications already containing joint actuation bearings or mounting systems, as there is no need for a second set within the motor.

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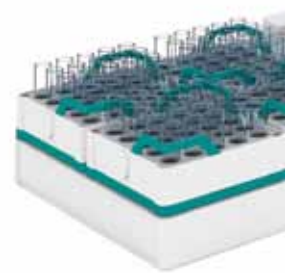
Due to a unique kinematic design the compact Wittenstein Galaxie drive systems and gearboxes are said to achieve high torque density, torsional rigidity, smooth running, positioning accuracy and completely backlash-free operation.

The Galaxie drive system achieves almost full surface contact during power transmission. This gives a tooth contact surface that is 6.5 times larger compared to conventional involute teeth with typical linear contact. The gearbox is claimed to be the only one of its kind in the world to guide a large number of individual teeth along an internal ring gear.

The modular range with four variants and five sizes now includes the Galaxie D Drive System in size 085, which is designed for use in axes with high compactness and precision requirements. It also particularly targets applications where high torsional rigidity and freedom from backlash are called for rather than torque. Even in this compact version, the Galaxie D delivers three times better torsional rigidity than a strain wave gearbox, and one and a half times the maximum output speed.

Treotham Automation Pty Ltd

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DATA ANALYTICS SOFTWARE

Seeq Corporation has released a second update to its Seeq software application in 2018, staying on plan to provide four releases each year. Seeq is an advanced analytics solution for engineers and scientists in process manufacturing organisations to rapidly collect, investigate and share insights on manufacturing data. Target markets include oil and gas, pharmaceuticals, chemicals, energy, mining, food and beverage, and other process industries.

Recent releases of Seeq have focused on enabling larger deployments through scalability features in the software by making the Seeq application easier to use. R20 features include the ability to have live updates to Seeq Topics, which are a way to publish insights from Seeq to other users; expanded machine learning functionality for customers doing predictive analytics with Seeq; and an improved query model for customers bringing in contextual data from SQL-based data sources to provide faster connections to big data sources.

These features are in addition to addressing requests from users in the Tools Panel, scripting and administration capabilities. Finally, Seeq R20 includes integration support for Inductive Automations' Ignition SCADA system including integrated display window capabilities.

Seeq continues to partner with many process automation firms, including Emerson Electric, Honeywell, Schneider Electric and OSIsoft. It also provides support for leading data historians, including OSIsoft PI System, GE Proficy, AspenTech IP21, Emerson DeltaV Continuous Historian and Ovation DCS Historian, Honeywell Uniformance PHD Historian, Rockwell Automation FactoryTalk Historian, Inductive Automation's Ignition Historian, DataParc Historian, Aveva's WonderWare Historian, Citect SCADA and eDNA Historian.

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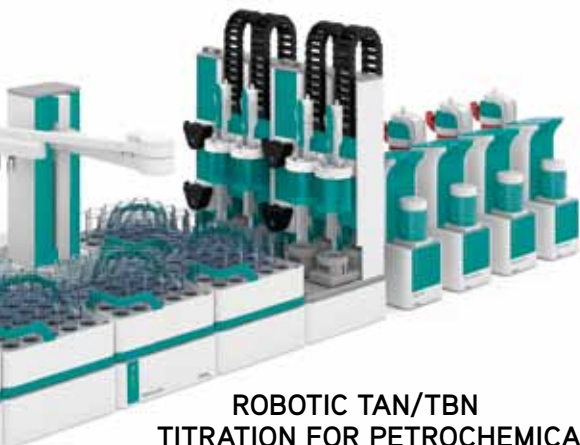
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ROBOTIC TAN/TBN TITRATION FOR PETROCHEMICAL SAMPLES

Metrohm has announced a fully automated solution for the determination of total acid number (TAN) and total base number (TBN) in up to 112 samples. The solution is based on the OMNIS Sample Robot and addresses the needs of QC laboratories in the petrochemical industry as well as contract laboratories looking for an efficient solution to cope with high sample loads at the lowest possible cost per sample.

On the OMNIS Sample Robot, the entire analysis is performed in a closed system, so there is no risk of physical contact with solvents or reagents at any time. For reproducible results, the sensor of the system is rinsed and conditioned after each determination. For increased safety and convenience, the system can be operated in any standard size fume hood.

The OMNIS Sample Robot can be expanded in three steps from size S to M to L, which accommodates up to 112 samples evenly distributed over seven racks. OMNIS is flexible: racks with urgent samples can be prioritised and placed on the sample robot while the system keeps analysing.

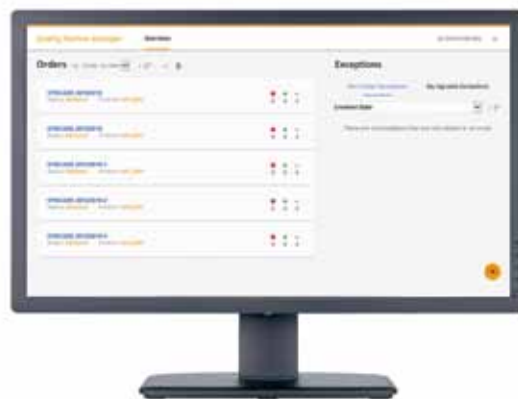
Maximum throughput on the OMNIS Sample Robot is achieved using the possibility to perform up to four titrations in parallel at four workstations, saving up to 60% in time compared to titration at a single work station.

Metrohm Australia Pty Ltd
metrohm.com.au

PHARMACEUTICAL QUALITY CONTROL SOFTWARE

Emerson has released Quality Review Manager, a software application designed to reduce the time it takes to release therapies to patients by decreasing the time and effort required for product quality reviews. Delivered as part of the Syncade manufacturing execution system (MES), the tool is designed to help life sciences companies more easily adopt review-by-exception operating approaches, allowing quality and manufacturing personnel to safely release batches faster, reducing inventory and time to market.

Today most review teams must wait until after an entire batch is complete before reviewing process exceptions. With Quality Review Manager, the quality department can review process exceptions as they occur and while the batch is still in process, providing a more timely response. Exception reviews can be completed within hours of the exception occurring, rather than weeks after the batch has been completed, eliminating potential delays in releasing product to patients.



Providing a single environment for reviewing exceptions, Quality Review Manager speeds up the process of managing exception documentation by auto-generating data that provides context for each exception. Exception dashboards help prioritise reviews while focusing on the most critical exceptions affecting the process. After all exceptions are closed, Quality Review Manager supports an automated release methodology by immediately releasing finished batches once all exceptions are resolved.

The web-enabled tool, accessible through traditional workstations and modern mobile devices, facilitates collaboration among stakeholders and quality personnel by making documentation and other relevant information available anywhere.

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FACTOR 1 SENSORS

THE EVOLUTION OF METAL DETECTION

Sensing different metals with traditional inductive sensors is difficult without physically moving the sensor, but factor 1 sensors can detect any metal at the same distance.

For years, standard proximity sensors have been used in applications requiring metal detection, ranging from packaging and material handling to agriculture to oil and gas. Engineered as an early solution to achieve consistent metal detection, standard proximity sensors were widely used in a variety of applications, from detecting aluminium cans on an assembly line to sensing a steel gate on a tank. Though a popular solution, these devices present challenges in applications that require reliable metal detection.

Sensing metal components can be difficult given the wide range of ferrous and nonferrous metals and range of thicknesses. Obtaining reliable results for multiple metals with a single proximity sensor can be problematic given the limitations associated with this technology. For instance, traditional sensors are incapable of sensing all metals at the same distance, which results in mounting adjustments that may not be supported by an application's operation specifications. These adjustments significantly impact productivity by requiring frequent machine halts. Additionally, standard proximity sensors lack flexibility and durability, often making them unsuitable for today's demanding industrial requirements.



Inductive sensors

With the development of factor 1 sensing technology, featuring increased reliability, enhanced versatility and improved durability, these solutions can accommodate modern industrial environments. This technology enables a single factor 1 sensor to be used to accurately detect aluminium, stainless steel, mild steel, copper, lead, brass and other metals at the same rated distance — without altering the position of the device. Further, their inherent durability limits the replacement costs and inventory overhead associated with standard proximity sensors. With versatile housing options and mounting capabilities, factor 1 sensors are able to accommodate a wider range of applications and environmental conditions.

Performance limitations associated with standard proximity sensors

Traditional inductive proximity sensors are designed for wear-free, non-contact detection. Featuring a coil and ferrite core arrangement, they generate a high-frequency electromagnetic field. When a target passes through the magnetic field, currents induced on the surface of a target result in the loss of energy in the oscillator and

generate a signal to turn the solid-state output on or off. Once a metal object exits the sensing field, the oscillator regenerates and the sensor returns to its normal state.

Sensing range

The operating range of standard proximity sensors varies based on the type of metal being detected. The sensing range essentially is a function of the diameter of the sensing coil and the rated operating distance, which is used to designate the nominal operating distance. However, this rated operating distance does not factor in manufacturing tolerances or variations due to external conditions, such as voltage or temperature, which can affect the sensor's ability to deliver consistent performance.

Proximity sensors react differently to ferrous and nonferrous metals, which impacts the operating distance of the sensor. To achieve optimal performance in applications that require the sensing of nonferrous metals, the sensing range must be adjusted to accommodate a correction factor (Table 1). These correction factors are nominal values, with deviations due to variations in oscillator frequency, alloy composition, purity and target geometry.

Inductive sensors

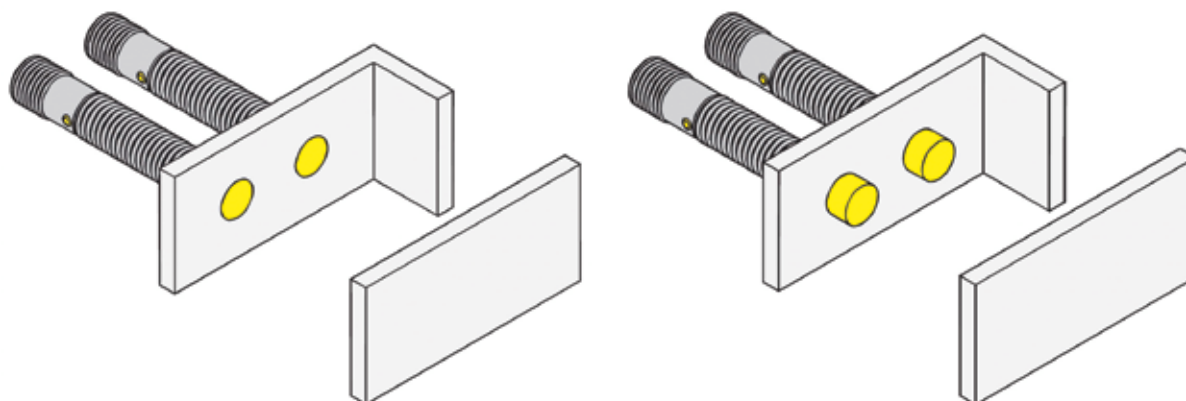


Figure 1: Embeddable and non-embeddable sensor mounting.

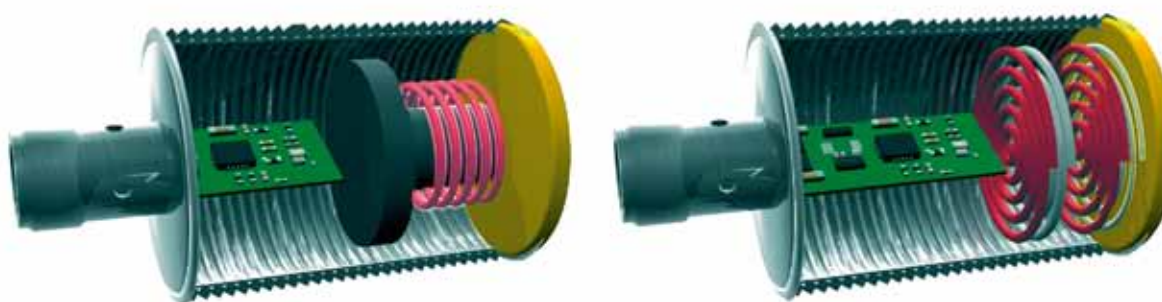


Figure 2: Instead of a single coil inducing and being affected by eddy currents on a target (left), factor 1 sensors use separate, independent sender and receiver coils (right).

The standard operating range of a proximity sensor is based on its response to a 1 mm thick square piece of mild steel, which is between 7 and 8 mm from the target. When sensing a different metal component, the sensor must be adjusted. The more conductive the metal is, the closer the sensor must be mounted to the object to achieve reliable results. For example, when sensing aluminium, the operating range is reduced by 20–30% — making it approximately 2 mm shorter than the standard range.

Mounting

Standard proximity sensors allow both embeddable and non-embeddable mounting, which allows versatility and creates additional considerations, such as reduced sensing range, magnetic interference and mechanical vulnerability.

When the sensor is designed for embeddable mounting, it includes a metal band (shield) that surrounds the sensor, minimising magnetic interference.

The oscillator creates a high-frequency field radiating from the coil in front of the sensor, centred around the axis of the coil, and

the ferrite core bundles and directs the electromagnetic field to the front of the sensor. Embeddable sensors can be flush-mounted in metal to provide a degree of protection from incidental contact and mechanical damage. Though embedded mounting offers some safeguarding, it also results in a reduced sensing range.

Non-embeddable sensors do not have the metal band and therefore must be mounted in a metal-free zone. Metal parts near a non-embeddable sensor can influence the electromagnetic field and impact sensor operation, causing false results. Though non-embedded mounting provides a longer sensing range, the sensors protrude from the mounting surface, making them more susceptible to physical damage from the target hitting the sensor as it passes or from accidental human contact.

Other influences make both embeddable and non-embeddable sensors mechanically vulnerable, including temperature and voltage variations, and industrial factors such as exposure to high levels of noise or weld fields. Additionally, mounting standard proximity sensors can also be challenging in applications with limited spacing. If the application requires multiple sensors to be mounted in close proximity, it can cause coupling between the oscillator coils, which then causes the sensors to trigger each other. Sensor manufacturers have different requirements for the mounting space between their sensors, but using sensors with different frequencies can lessen the spacing needed.

Cost considerations

Standard proximity sensors are not constructed to withstand extreme variations in temperature, heavy vibration or washdown conditions. This requires manufacturers to keep a large supply of sensors on hand to replace damaged equipment. Additionally, given that these sensors are prone to breakage, this causes frequent production halts, impacting profitability through lost productivity.

Target material	Correction factor
Aluminium Foil	1.00
Stainless Steel	0.6 – 1.00
Mercury	0.65 – 0.85
Lead	0.50 – 0.75
Brass	0.35 – 0.50
Aluminium (massive)	0.35 – 0.50
Copper	0.25 – 0.45

Table 1: Correction factors for standard inductive sensors when detecting nonferrous metals.



TO ACHIEVE OPTIMAL PERFORMANCE IN APPLICATIONS THAT REQUIRE THE SENSING OF NONFERROUS METALS, THE SENSING RANGE MUST BE ADJUSTED TO ACCOMMODATE A CORRECTION FACTOR.

The need for sensor advancement

One range for all metal detection

Factor 1 sensors use multiple coils that enable them to detect all metals at the same range without requiring adjustment. Instead of a single coil inducing and being affected by eddy currents on a target, factor 1 sensors use separate, independent sender and receiver coils. This design affords factor 1 technology multiple benefits over standard proximity sensors, including metal detection reliability, mounting versatility, enhanced durability and improved productivity and profitability.

By detecting both ferrous and nonferrous components at the same operating range, these sensors provide an overall longer operating range. Further, since these sensors are inherently immune to magnetic field interaction, they are ideal for applications where alternative technologies would fail due to interference with magnetic fields, such as welding, lifts and electronic furnaces.

Mounting versatility

Due to their design and construction, factor 1 sensors can be mounted further away from the target, protecting them from damage. The absence of a ferrite coil also enhances mounting versatility by accommodating small spaces and metal-free mounting zones. Further, with embeddable designs and recessed mounting for non-embeddable options, factor 1 sensors suit diverse application requirements.

With these mounting capabilities, factor 1 technology avoids mechanical damage due to physical contact by a target or user. Recessed mounting protects sensors from industrial conditions that make both embeddable and non-embeddable sensors mechanically vulnerable, including temperature and voltage variations, and environmental factors such as exposure to washdown, high levels of noise or weld fields.

Their ability to sense any type of metal at the same operating range accommodates applications with limited space mounting. By not requiring personnel to manually manipulate the sensor's position, a single factor 1 sensor can be mounted in small or difficult-to-access areas where both ferrous and nonferrous metals must be detected. This is also beneficial in situations where implementing a larger sensor is not feasible.

Durability and flexibility

Factor 1 sensors are designed for durability and performance flexibility. With a variety of housing options available, improved cap designs and resistance to harsh industrial environments, factor 1 technology can withstand a variety of demanding applications.

To accommodate specific application requirements, factor 1 sensors can be constructed within a variety of housing materials, including plastic and metallic options. Further, instead of the sensor diameter being dictated by the size of the ferrite core or coil arrangement, the factor 1 sensor's PCB can be designed for virtually any size and style of housing, including ring-shaped, rectangular and barrel.

Along with diverse housing options, factor 1 sensors are also engineered using more durable caps, with some manufacturers using plastic caps and others incorporating O-rings. Manufacturers have also potted these sensors with different materials and modified the connector inserts for enhanced durability. These improvements not only prevent moisture and particle contamination from damaging the sensor, they also enable the device to withstand harsh conditions. This allows these sensors to accommodate industry applications with stringent sanitation regulations, such as pharmaceutical or food and beverage, enabling sensors to resist high-pressure, aggressive cleaning agents and sudden temperature variations common in washdown conditions.

Another example of factor 1 technology's versatility includes small part detection. By utilising a rectangular-style housing for small part detection on the outside of the tube instead of using a standard ring-style proximity sensor, a single factor 1 sensor can replace multiple different sensor types, resulting in reduced inventories and less maintenance.

Productivity and profitability

With the performance advantages inherent in factor 1 sensors, manufacturers can increase both productivity and profitability. Their sensing capabilities allow one sensor to accurately detect all metals at the same range, providing continuous production without requiring unnecessary halts to adjust sensors detecting multiple types of ferrous and nonferrous metals.

Since factor 1 technology is engineered to enhance durability and its mounting flexibility improves sensor protection, it presents cost-saving benefits, as less sensors will fail due to mechanical damage associated with exposure to elements or incidental contact during production. Through this technology, manufacturers can minimise their sensor replacement costs.

Further, the elimination of manual manipulation and equipment replacements also increases cost-efficiency from a labour perspective. By minimising maintenance required for continual performance, manufacturers will reduce the cost needed to sustain sensors operation. Additionally, with less production downtime, users can increase overall profitability by minimising lost revenue due to process interruption.

Conclusion

With an advanced design, and lacking a ferrite core, factor 1 technology provides flexibility in both mounting and performance capabilities. Delivering extended range, recessed mounting capabilities, unique housing styles and washdown-suitable properties, factor 1 sensors offer a viable replacement option for standard proximity sensors to better meet today's diverse and demanding application requirements. Factor 1 technology minimises production downtime and reduces maintenance requirements to promote overall process efficiency, productivity and profitability.

Turck Australia Pty Ltd

www.turck.com.au



Anaerobic digestion provides major savings for malt producer



Muntions is a major producer of malt products, best known in Australia for its range of home beer making kits. The company is also a leader in sustainable production; since 2016 it has operated a closed-loop system which turns liquid malt waste into a high-quality biofertiliser at its production plant in Suffolk, England.

The basis of the system is a \$9.4 million, 499 kW on-site anaerobic digestion (AD) plant which generates 25% of the site's electricity. Each year the plant turns 80,000 tonnes of liquid malt waste into quality organic digestate fertiliser, which is used by the company's network of growers to produce some of the 250,000 tons of barley needed to make 180,000 tons of malt each year.

Muntions first became interested in AD after analysis showed that 60% of the carbon footprint of its supply chain came from the artificial fertiliser used by its barley growers. The company realised that if a proportion of the liquid waste it produces could be treated through AD, it could produce a high-quality organic biofertiliser for its farmers to use instead.

The new treatment also captured nutrients such as phosphate, which were previously lost when treated effluent was discharged to the river. The digestate product is high in organic matter and acts as a soil conditioner and improver. It can also be applied to land over a longer period of time than the liquid waste which was previously produced.

Muntions' digestate is blended with low chemical oxygen demand (COD) effluent before being treated with dissolved air flotation (DAF) in Muntions' existing activated sludge plant. This stabilises the digestate and removes further COD, nitrates and phosphorus prior to the effluent being discharged to local waterways. The remaining sludge is then pasteurised in a three-tank unit from HRS Heat Exchangers and used as biofertiliser.

The HRS system works so that while one tank is being filled, the second tank holds the sludge at 70°C at the same time as the third tank is being emptied (each process lasts one hour). Waste cooling water from the CHP engine is used to heat the sludge in corrugated tube-in-tube heat exchangers, which is more efficient than heating an entire tank of digestate.

HRS has also incorporated an energy recovery section into the process to make it even more efficient: energy is transferred from the hotter (pasteurised) sludge to the colder (unpasteurised) sludge,

reducing energy consumption by up to 70% compared to conventional systems and using heat which would otherwise be wasted. It is able to run at a half flow rate, should the volume of digestate stock reduce, and the equipment's monitoring features ensure that every batch of digestate can be traced back to the feedstock from which it was produced.

Once pasteurised, the biofertiliser can be de-watered if required and supplied for application either as a liquid for soil injection or a solid for muck spreading. Analysis by Muntions has shown that its biofertiliser is higher in nitrogen, potash and sulfur than most other available biosolids, as well as being a good source of phosphate and magnesium.

The system has so far treated almost 150,000 m³ (150 ML) of effluent, saving the company more than \$5.95 million in electricity and waste disposal costs and reducing carbon emissions by 800 tonnes. The resulting material has been granted End of Waste Certification by the UK Environment Agency, meaning that it can be used as a biofertiliser.

"For Muntions this whole project has been about maximising efficiency," said Matt Hale, International Sales and Marketing Director at HRS. "Although they have an abundance of heat, they still wanted to recapture what they could and our heat exchangers provide 40% heat regeneration. Our system also allows the tanks to run at half flow rates if necessary, meaning they can still carry on pasteurising without having to wait to build up a stock of digestate."

"Working with a company like Muntions to deliver a truly revolutionary waste treatment plant shows exactly what is possible in terms of implementing the circular economy. The results that the biofertiliser is providing in trials and in the field show just what a valuable resource it is."

HRS Heat Exchangers Australia New Zealand

www.hrs-heatexchangers.com

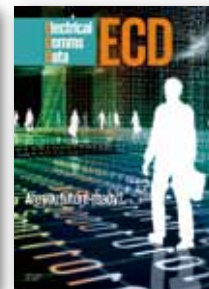
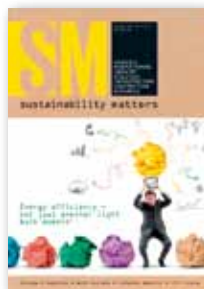
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AS I SEE IT



A WORLD OF TRUE OPEN CONNECTIVITY

We live in an age of entrenched connectivity. We have the internet, Wi-Fi and the almost universal uptake of communication systems like Ethernet networking.

Yet one of the most common complaints from the manufacturing industry has been the lack of connectivity on the factory floor. The absence of interoperability between devices has made data gathering and sharing much harder than it needed to be and created much unnecessary frustration.

However, the reason devices from different vendors can't talk to each other or the internet isn't due to the communication systems being used; it's the lack of a commonly accepted protocol and methodology suitable for industrial applications.

Industry has however been driving for change and the first credible solution came in 1996, when a consortium of automation vendors partnered with Microsoft to create the OPC DA standard (now often called OPC Classic). OPC isn't just a protocol; it's a collection of interfaces, objects and methods that are designed specifically for the automation industry.

Many hardware vendors came on board and produced dedicated server programs that connected to their devices and presented OPC-formatted data for clients to use. Client uptake was strong in certain market sectors — namely HMI and SCADA, where suppliers had previously fashioned a custom driver for each unique device. OPC greatly reduced this burden.

The OPC Foundation was later formed as a vendor-neutral organisation, to promote and develop the OPC standard. Amendments were made but, as technology advanced, numerous limitations became apparent.

Recognising needs were changing, the OPC Foundation produced the OPC UA (Unified Architecture) standard in 2008 (IEC 62541). While remaining completely backward compatible to OPC DA, this revision ensured full platform independence, meaning virtually any hardware or operating system could use OPC UA. X.509 authentication, security and encryption methods are also embedded.

As expected, OPC UA has been widely accepted in the decade since its release, particularly with the industry's uptake of cloud-based IIoT services. However, its usage has still been somewhat hampered and part of the reason is the relative difficulty in implementing OPC UA. Few devices had supported it natively, meaning users were forced into dedicated gateways (usually just programs running on Windows-based PCs) which only collate data from the factory floor and serve it to OPC UA clients. This extra complexity brought added costs, reduced response times and increased maintenance.

Nonetheless, this barrier is progressively being removed by devices themselves serving OPC UA data and providing direct connections to OPC UA clients. This applies mostly to automation controllers; not only are these widely connected on the factory floor, but their control capabilities make them silos of information. Direct connections are more efficient and simplify networks, as well as reducing both costs and maintenance.

Of course OPC UA isn't restricted to just controllers — it can be implemented in any device. I'm quite certain a day will come when virtually every device will be OPC UA enabled, without gateways.



Harry Mulder is Marketing Manager for Omron Electronics and

has been working with industrial control systems for almost 30 years. He has seen a great deal of change within the industry during this time but believes the recent developments have been the most exciting.



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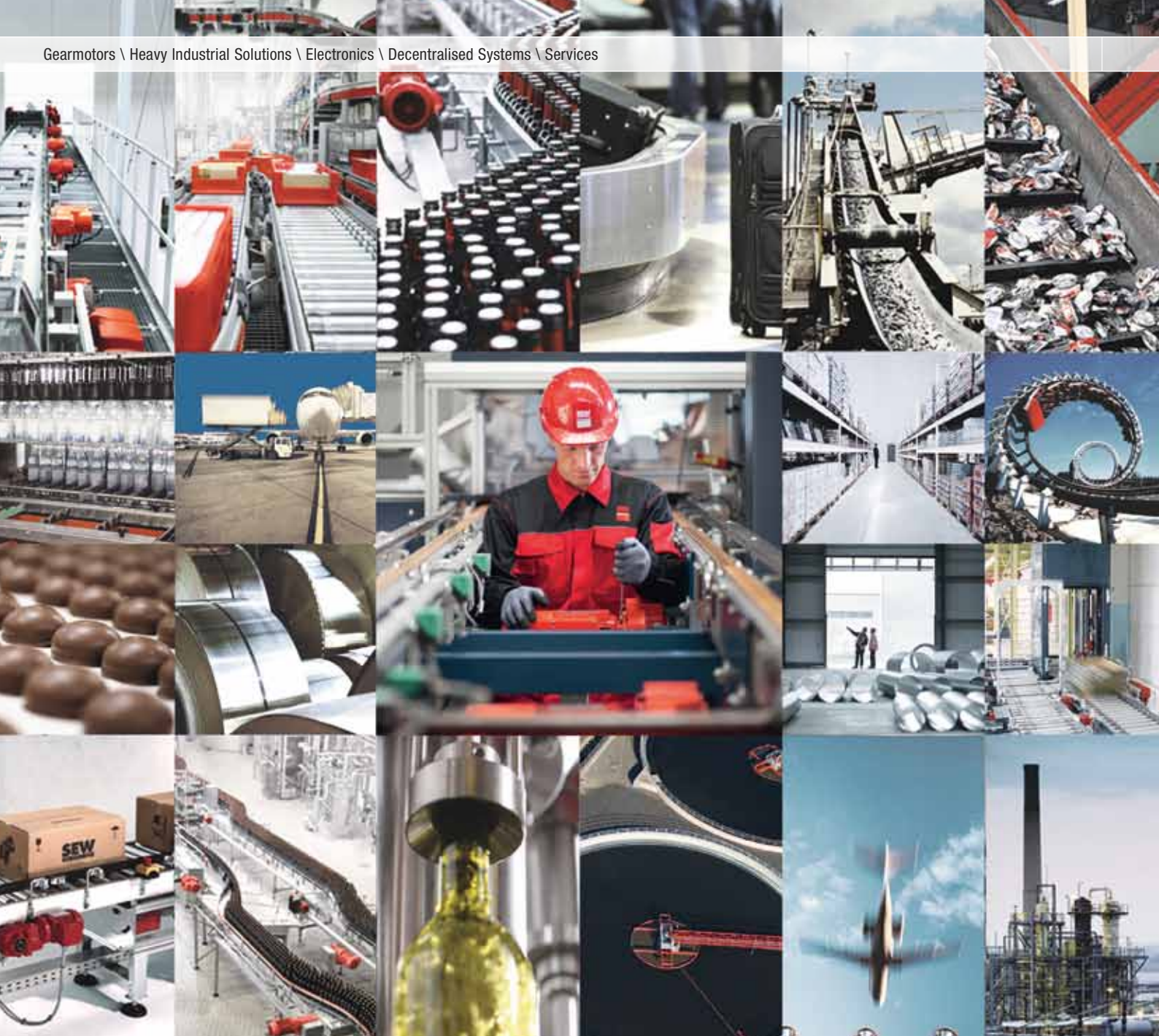
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