PROCESS TECHNOLOGY

AUTOMATION + CONTROL + INSTRUMENTATION

July 2022 vol.36 no.2

PP100007403

Rittal – The System.

Faster – better – everywhere.

Find out more:
www.rittal.com.au/CO2Footprint

Sustainability that works

Minimising CO_2 emissions – the Blue e+ way

Discover the world's most efficient climate control solutions and smart service concepts, guaranteeing the sustainability of machines and systems.

Annual carbon savings per unit equate to

CO_2 absorption of 80 trees

Sustainable use of resources

Speed-controlled cooling extends the working life of the components

ENCLOSURES | POWER DISTRIBUTION | CLIMATE CONTROL | IT INFRASTRUCTURE | SOFTWARE & SERVICES

FRIEDHELM LOH GROUP

RITTAL

0722

PROCESS TECHNOLOGY
JULY 2022

CONTENTS

ON THE COVER

MOVI-C is the all-in-one solution for automation tasks from SEW-EURODRIVE. Whether you want to implement standards-based single-axis or multi-axis applications, or customised, particularly complex motion control applications or automation solutions, MOVI-C can help you do all that and give you the scope to achieve optimum automation for new projects.

The benefits of the MOVI-C all-in-one modular automation system is that it is an end-to-end solution from a single manufacturer covering all your needs — planning, commissioning, operation and diagnostics software, electronic control and monitoring devices, mechanical drives and gearmotors. There is only one place you have to go to for all the automation components you need. All components can be fully integrated into all automation concepts, fieldbus topologies and network standards. You have complete freedom when it comes to the communication topology, as MOVI-C harnesses all communication advantages — from Profibus and industrial Ethernet to Modbus and, in the future, OPC UA.

MOVI-C offers automation and a whole range of benefits from a single source — specifically, a company that is both an automation specialist and a manufacturer.

The four components of MOVI-C are engineering software, control technology, centralised and decentralised inverter technology, and drive technology.

Together, these components form one complete, end-to-end modular automation system made up of devices and field units that you can combine to suit your requirements and bus topology perfectly.

SEW EURODRIVE

SEW-Eurodrive Pty Ltd
www.sew-eurodrive.com.au

SMART INSTRUMENTATION

MEETING THE CHALLENGES OF HYDROGEN PRODUCTION

Cornelia Huber, Marketing Manager, ABB Instrumentation

Using green hydrogen as a sustainable fuel source is generating great interest as companies and governments look for new ways to cut reliance on fossil fuels.

As the world undergoes geopolitical, security and environmental pressures that are driving countries worldwide to accelerate the development of alternatives to polluting fossil fuels, many companies and governments are looking for new options.

Hydrogen offers many of the advantages of both renewable generation and fossil fuels — it can be produced with low or zero emissions and can be readily stored and transported. It is also clean-burning, producing only water as a by-product, and can be used in chemical processing or production.

There are several ways to produce hydrogen and the key to gaining the most environmental benefit is to use a method that has the fewest emissions or harmful by-products.

Hydrogen production is generally classified as green, grey, blue, brown or white, depending on the production method used. For example, grey hydrogen is currently the most prevalent form of hydrogen production. It is derived from natural gas using steam methane reforming (SMR). This does not use carbon capture methods and for every kilogram of hydrogen produced by SMR, 10 kg of CO_2 is also produced.

Green hydrogen, on the other hand, is the most ecologically friendly type, produced by electrolysis using renewables or nuclear energy. The EU Hydrogen Strategy of 2020 places a strong emphasis on green hydrogen, with some tolerance for low-carbon hydrogen.

The potential of green hydrogen is particularly important for Australia. The government is investing $1.4 billion in building a hydrogen industry, with plans to position Australia as a major player by 2030.[1]

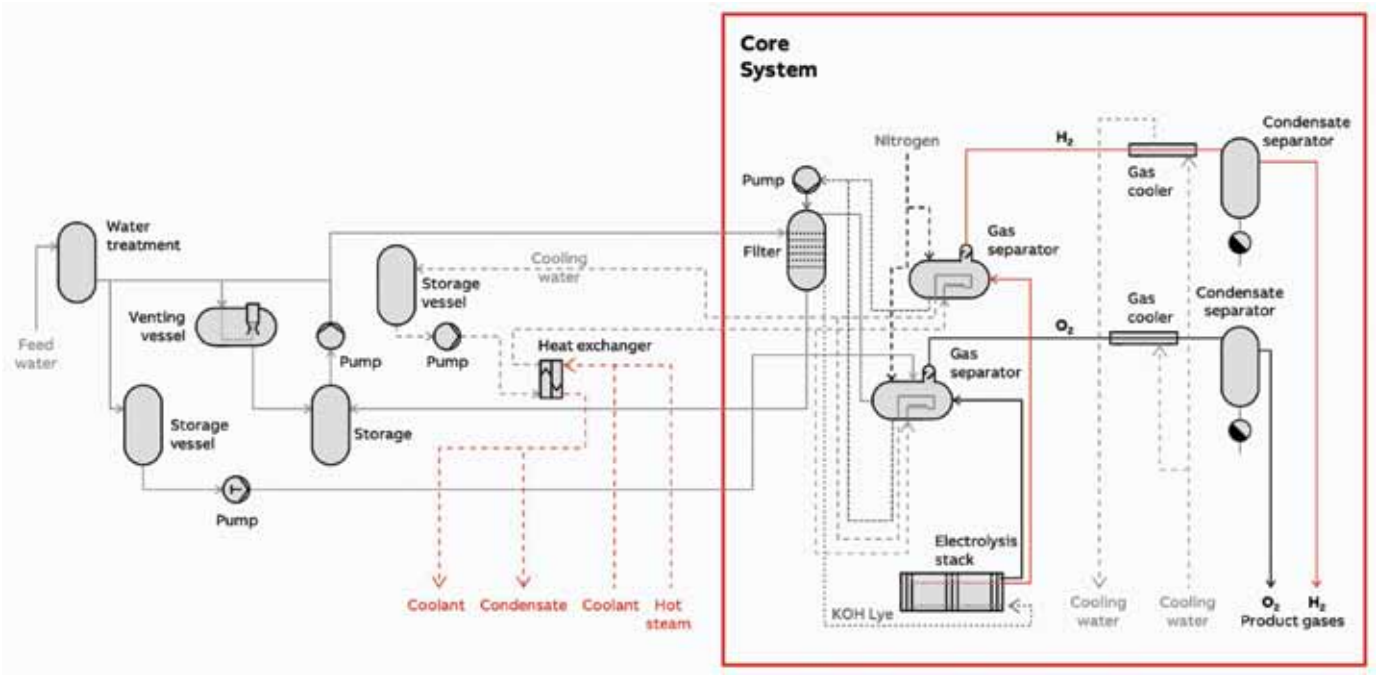


Figure 1: Process flow diagram of an AEC electrolyser with water treatment, phase separation, electrolyte recycling and cooling systems.

Producing green hydrogen

Electrolysers are the chief way of producing green hydrogen, as they use renewable electricity from wind, solar or hydroelectric power.

There are three main electrolysis methods used today. The first is alkaline electrolysis. A mature, commercial technology, this largely avoids the use of precious metals, and so has relatively low capital costs compared to other electrolysis methods. However, the process is difficult to start up or shut down and output cannot be quickly ramped up.

The PEM (proton exchange membrane) electrolyser uses pure water as an electrolyte solution. This avoids the need to recover and recycle the potassium hydroxide electrolyte solution used in alkaline electrolysers. The method can produce highly compressed hydrogen for decentralised production and storage.

The third and least developed method utilises solid oxide electrolysis cells (SOECs). Based on high temperatures, they use steam for the electrolysis process and so require a heat source.

Instrumentation requirements

The process of electrolysis involves several challenges and risk factors, not least of which is ensuring safe operation, achieving efficient power-to-hydrogen conversion, and controlling the hydrogen and oxygen gas purity.

ISO22734:2019, *Hydrogen generators using water electrolysis — Industrial, commercial, and residential applications*, is a standard that identifies many parameters that can be measured to ensure safe and reliable operation of hydrogen electrolysers. Some of the proposed parameters are specific to the electrolyser technology. An example is the detection of the leakage of hazardous liquids. This is more relevant for handling highly concentrated potassium hydroxide solutions on an AEC electrolyser, whereas it would not be so critical on a PEM system, which uses pure water.

Conversely, many of the measured parameters are common to all electrolysers, such as the need to avoid the risk of overheating in the electrolyser stack and the requirement to analyse gas purities.

Gas quality requires close monitoring

Hydrogen production needs close analysis to monitor gas quality and relative volumes. Essentially, electrolysers produce oxygen at the anode and hydrogen at the cathode — however, many reactions in the electrolyser can cause small concentrations of oxygen to build up in the hydrogen stream and hydrogen to build up in the oxygen stream. This is defined by ISO22734 as a fault condition and so must be detected by appropriate instrumentation.

This application requires a thermal conductivity detector gas analyser, which can measure traces of hydrogen in the oxygen stream and traces of oxygen in the hydrogen stream.

Liquid level monitoring in the phase separator

Another critical measurement task is monitoring the electrolyte vapours that are carried over from the electrolyser cell. After the electrolyser, an initial knock-down phase separator is used to force gas and liquid separation. Hydrogen is then cooled, and a second separation stage removes the condensate and maximises the effectiveness of the physical phase separation.

The first separation takes place in a vertical vessel. Here, hydrogen is vented from the top, while liquid from the base is pumped and recirculated to the electrolyser. The risk is that the pump will run dry, causing hydrogen to enter the pump then flow to the wrong part of the electrolyser. This makes it crucial to monitor the water level in the knock-down phase separator.

A typical solution for level monitoring in the phase separator uses a magnetically actuated double pole double throw switch. When mounted on a magnetic liquid level gauge, the switch can sense high or low levels within the phase separator.

Cutting the risk of overheating

Using renewable electricity from a solar park or wind farm, there is a risk that hydrogen production may ramp up as the electricity available varies. This in turn causes the current drawn by the electrolyser to increase, raising the stack temperature. As a consequence, temperature measure-

ment and cooling are required to eliminate the risk of overheating.

It is critical to monitor the temperature in the de-oxo unit to keep the reaction under control and ensure that the temperature does not reach a hazardous level. The most advanced temperature sensor solutions will offer continuous sensor monitoring and self-monitoring, including supply voltage and the possibility of wire breaks or corrosion.

Pressure measurement

Some types of electrolysers operate at elevated pressures. This is because feed water is sometimes pumped at high pressure to avoid the cost of compressing the produced hydrogen. It is therefore necessary to use instrumentation to continuously monitor the water feed pressure, as well as that of the hydrogen and oxygen, using instruments that provide for shielding against hydrogen permeation.

Pressure instruments are also needed to ensure that the generated hydrogen and oxygen are flowing away without obstruction, as over-pressurisation of the equipment could lead to unsafe conditions.

Digitalising hydrogen production

As with most industrial processes, digital instrumentation is making its presence felt, bringing major benefits to the production and control of hydrogen electrolysis. Digital instrumentation offers significant benefits over older analog-based units. Among these are greater accuracy, range and depth of information, meaning that digital technology offers operators and process engineers a highly detailed picture both of operating conditions and the status of their measurement equipment.

> THE PROCESS OF ELECTROLYSIS INVOLVES SEVERAL CHALLENGES AND RISK FACTORS, NOT LEAST OF WHICH IS ENSURING SAFE OPERATION, ACHIEVING EFFICIENT POWER-TO-HYDROGEN CONVERSION, AND CONTROLLING THE HYDROGEN AND OXYGEN GAS PURITY.

They also offer great flexibility — rather than being restricted to sending a single measurement to work on, digital instrumentation allows additional measurements to be sent along with the primary measurement, such as density, temperature or pressure.

Advances in digital techniques mean that much more diagnostics information is available remotely, while an instrument's configuration can also be changed this way. Getting status updates cuts maintenance time and costs, ensuring engineers are only deployed as needed. It also means any problems in the process being measured can be resolved before they escalate. This can be critical in electrolysis as parts of the electrolysis stack can be damaged if conditions veer away from nominal.

With digital data, trends in the electrolysis process are much easier to access and analyse as it can be interpreted and turned into easily readable graphs. Using these, engineers can tell when an event such as oxygen entering the hydrogen stream occurred, as well as how changes in parameters could have caused it.

Process instrumentation that can provide analysis as well as detailed readings can also mitigate the endemic skills shortage, helping young or inexperienced plant personnel. In many cases, familiar everyday technologies such as QR codes are being used to display device maintenance and operating conditions. By scanning the QR code with a smartphone, an engineer can send data about the instrument to its manufacturer to access remote assistance.

Remote support is a major theme in today's instrumentation. Condition monitoring tools are often used to confirm the health of measurement devices and streamline their servicing. Automated device testing improves the quality and consistency of measurements, giving better results, while sending data to a manufacturer's service experts can ensure maximum availability. This is critical in electrolysis where the constituents of the gas stream are a critical safety issue and demand constant monitoring.

When used to their full extent, the expanded capabilities offered by digital instruments can bring real benefits to green hydrogen production. They enable maximum productivity through ensuring high reliability and availability of instrumentation, while also providing a wealth of actionable data to keep the process parameters in check.

By keeping the electrolysis process safe, efficient and productive, digital instruments ensure that green hydrogen is on a firm footing to become a sustainable energy source for the future.

1. Department of Industry, Science and Resources, *Growing Australia's hydrogen industry*, Australian Government, ‹‹https://www.industry.gov.au/policies-and-initiatives/growing-australias-hydrogen-industry››

ABB Australia Pty Ltd
www.abbaustralia.com.au

HOT PRODUCTS
ON WWW.PROCESSONLINE.COM.AU THIS MONTH

HAZARDOUS AREA HUMIDITY AND TEMPERATURE SENSORS

Galltec+Mela has released a range of humidity and temperature sensors with ATEX certification for use in potentially explosive atmospheres.

Slentech Pty Ltd

https://bit.ly/3IbbQSJ

MODULAR PANEL PC

Advantech has introduced the TPC-B610 series as the latest member of its modular TPC computing box series.

Advantech Australia Pty Ltd

https://bit.ly/3bR1GKH

CYLINDRICAL PHOTOELECTRIC SENSORS

Pepperl+Fuchs M18 series cylindrical photoelectric sensors are designed for functionality and can be flexibly selected depending on the application requirements.

Pepperl+Fuchs (Aust) Pty Ltd

https://bit.ly/3NN8FS9

MULTIFUNCTIONAL SENSOR

The ODT 3C sensor from Leuze is designed to handle both measuring and switching tasks.

Leuze electronic Pty Ltd

https://bit.ly/3IfuDfN

p|m|v

energy saving compressed air technology

Clean, reliable efficiency for industry

Kaishan's revolutionary range of Permanent Magnet Rotary Screw Compressors deliver up to 50% energy cost savings over conventional compressors with equal or greater output.

From 250 to 15kW, these advanced machines utilise systematic optimisation of the airends through permanent magnet drive motors and variable speed drive technology to achieve higher efficiency at all operating speeds.

Advanced 2-Stage technology generates more air and ensures longer bearing life.

- Certified food grade lubricants
- Controlled air output to meet demand
- No start-up spikes and cost penalties
- Reduced part load energy consumption
- Significantly lower noise levels

WE HAVE THE RIGHT COMPRESSED AIR SYSTEM FOR EVERY APPLICATION

From heavy industry to small workshop applications, we offer energy efficient compressors backed by 24/7 Australia wide support and service.

KAISHAN COMPRESSORS

National Sales and Service

1300 098 901

www. kaishan.com.au

KAISHAN

Engineering the Future

Combined sleever and cartoner reduces dairy packaging footprint

Real Dairy is a 100% Australian owned and operated company, with sites across Queensland, New South Wales and Victoria. The company produces their own speciality cheese products and supplies these to retailers across the country.

In an Australian first, Australian machine builder HMPS Group (HMPS) has designed and developed a sleever and cartoner in one footprint for Real Dairy. Adam Read, Sales Manager at HMPS, explained that this first-of-a-kind machine offers a small footprint, enhanced efficiencies and long-term cost savings.

"The system can handle pre-glued sleeves in 2-, 3- and 4-cell trays at up to 180 trays/min for the 2-cell trays," he said. "With minimal changeover it can also operate as an end load cartoner erecting, loading and hotmelt sealing primary cartons."

HMPS began in 1980 and has since specialised in the design and manufacture of automated processing and packaging solutions. In this case, HMPS supplied two complete units for this project, allowing Real Dairy to handle up to 360 trays/min.

"Combining two machines into one is extremely complex but rewarding — particularly for the end user," Read said. "Generally, these tasks would be handled by two different machines, and in this case, we had to figure out how to fit four machines into two machines."

Upon entry into the machine, the product (cheese and cracker packs) is transported through the machine along the main index conveyor where a sleeve is then applied to the product. The finished product is then fed through the inkjet printer where a defined code is applied. It is then transferred to an outfeed conveyor.

The machine includes an added capability as Read explained: "It's also required to end load a preformed carton to layer-pack the product. After merging, the product is routed to a separate area of the machine where it is collated into its final layer form for presentation to the carton."

The carton is erected onto the main index conveyor and traverses along the machine to a point where the product is end loaded. The product then moves to the next station where glue is applied and the flaps are closed. The completed final product is then moved along and past the inkjet printer where the defined coding is applied. The product is then conveyed to Real Dairy's conveyor.

Answering to the call for real-time monitoring and support, HMPS also provided HMPSConnect to Real Dairy. "This software enables the customer to monitor the throughput, productivity and effectiveness in real time," Read said.

Spiro Michas, CEO of Real Dairy, added that the new HMPS machinery is a major improvement in how things are done.

"At Real Dairy we don't want to do things 'as it has always been done'. We want to be at the forefront of new technology so it's critical that we partner with other leaders in industry — like HMPS.

"We have seen a significant redeployment of labour thanks to the throughput and efficiencies of this new development. The quality systems in place also result in less wastage and a safer operating environment," Michas said.

He comments that as in most facilities, space is often a consideration. "In this case HMPS had to design a machine with a small footprint to work within our existing floor layout. They came up with a solution that was not only fit for purpose but also flexible enough to adapt to future packaging demands."

Michas also highlighted another innovative feature — the LED doors on the machine. "These offer clear communication on the floor and highlight where the machine needs attention."

To conclude, Michas said that the greatest highlight of this project was 'supporting local'.

"We had international companies quote as part of the tender process, but HMPS still won the job based on innovation and their track record. I am happy that we could keep this project on our shores as I really believe that we should be supporting local as much as possible," he said.

HMPS
www.hmps.com.au

OPTIMA

Powerful handheld multigas analyser measuring up to 7 gas components

O_2 | C O | CO_{high} | N O | NO_2 | N $O_{(x)}$ | SO_2 | H_2S | CO_2 | H C

This next generation multigas unit has some great features and advantages for measuring emissions from combustion and industrial processes.

Some of the important highlights are:

- New Higher Resolution 4” Display, giving more information & improved resolution.
- New user-friendly menu design.
- 7 Measured Values, plus Graphical Progress Trends on screen.
- Integral NDIR Optical Bench for direct measurement of Carbon Dioxide & Hydrocarbons.
- Display zoom functions.
- Easy Communication Connections.

T 07 3255 5158
info@groupinstrumentation.com.au
www.groupinstrumentation.com.au

MRU since 1984 ®
AIR fair
EMISSION MONITORING SYSTEMS

GROUP INSTRUMENTATION

NEW PRODUCTS

AUTONOMOUS MOBILE ROBOT

Konica Minolta Australia has announced the MiR1350 from Mobile Industrial Robots (MiR). It is said to be the most powerful autonomous mobile robot (AMR) to be developed by MiR to date, offering a high payload (up to 1350 kg) for transportation of heavy items, a robust design for long-term serviceability and smooth navigation. It is the first MiR AMR with an IP52 rating, with enhanced and protected components to withstand dust particles and fluids, and is designed based on ISO3691-4 safety standards.

The robot has specially designed pallet lifters giving it the ability to automatically lift, transport and deliver pallets. This provides a safe alternative to traditional pallet lifters and trucks that require humans to operate them. The product safely manoeuvres around obstacles including humans. Its technology and software also mean it can navigate autonomously and choose the most efficient route. The AMR is equipped with laser-scanner technology and has 360° vision, along with two 3D cameras in the front to see from 30 to 2000 mm above the floor, and two sensors in each corner to see pallets and other obstacles that are so low that they are usually difficult for robots to detect.

Konica Minolta Business Solutions Australia Pty Ltd
www.konicaminolta.com.au

CUSTOM PNEUMATIC CONVEYORS

EXAIR's Line Vac air-operated conveyors are designed to provide an efficient method of converting ordinary pipe, hose or tubes into in-line conveyors. To accommodate the wide variety of problems manufacturers face, the company has the ability to customise and tailor Line Vacs to different specifications. Certain processes may require customisations like unique sizes, shapes and materials in order for the product to be a good fit for their system. EXAIR will work in collaboration with the user to fabricate the best possible solution.

For users with space limitations, smaller sizes can be created while still offering the same level of conveyance. In situations where the conveyor requires a specific flange mounting option, EXAIR can accommodate. Locations requiring custom mounting holes, brackets or inlet positions are also possible. For applications where stock aluminium or 303 and 316 stainless steel won't work, alternate materials like PVDF, OVC or PTFE can be utilised. For extreme environments, the company can produce both heavy-duty or high-temperature versions.

Stock models include standard, heavy-duty, high-temperature, light-duty and sanitary flange versions.

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

EDGE INTELLIGENCE GATEWAY

Advantech's UNO-430 is an edge intelligence gateway that can be employed in harsh industrial environments. It features IP69K/68-rated ingress protection and M32 and M12 I/O connectors to provide a watertight solution that can withstand demanding applications.

The waterproof enclosure features a front door for easy access and maintenance as well as a cable gland that offers further ingress protection, reducing the need for waterproof cables and wiring. This comprehensive protection also eliminates the need for a waterproof cabinet, allowing the UNO-430 gateway to be used as a standalone data acquisition gateway. The IP69K rating indicates that UNO-430 can withstand high-pressure and high-temperature washdowns and steam-cleaning, while the IP68 rating indicates the ability to withstand immersion in water under pressure for long periods, providing sufficient protection in case of exposure to chemicals or bad weather.

With the provision of standard M.2 2230 Wi-Fi and M.2 3052/3042 5G/LTE sockets, the UNO-430 gateway offers expandable wireless connectivity for remote communications and data transfers. To ensure flexible and convenient deployment in diverse usage scenarios, UNO-430 also supports a wide operating temperature range (-40 to 70°C) and input voltage (10–36 VDC), making it suitable for general outdoor and indoor installations, including roadside and manufacturing sites.

Advantech Australia Pty Ltd
www.advantech.net.au

CIPable Unbreakable PH Sensor

Say Godbye to Broken Glass Sensors

METTLER TOLEDO launches breakthrough X-Chip™ technology, InPro™ X1 pH sensors. New InproX1 pH sensors are CIPable, unbreakable, enabling in-line pH measurement in applications with the highest product safety requirements.

- **Exceptional measurement accuracy** for **measuring in-line** leading to higher product quality and increased yield.
- **Sanitizable using standard industrial processes** without the need of expensive and maintenanceheavy retractable equipment.
- **Easily implemented** with the same standard operating procedures valid for glass pH electrodes.

- ☑ pH/ORP
- ☑ Conductivity
- ☑ Dissolved Oxygen/ CO2
- ☑ Turbidity/Color
- ☑ Automation
- ☑ Mounting Accessories
- ☑ Water Analyzers

Scan the QR Code to know more about InProX1

Learn more about Process Analytics Instruments

www.mt.com/pro

METTLER TOLEDO

UNDERSTANDING FIREWALL TECHNOLOGY FOR INDUSTRIAL CYBERSECURITY

PART 2

*Dr Tobias Heer, Dr Oliver Kleineberg and Divij Agarwal**

By combining different firewall functions in an overall network defence strategy it is possible to design networks that are prepared for the future.

In Part 1 of this article we discussed the general functions of a security firewall, and its placement within, and at the boundaries of, an industrial network. Once the required locations of firewalls have been determined, the type of filtering and the ongoing management of the firewalls needs to be considered.

Security in other network infrastructure

As part of Defence in Depth, it is useful to restrict communication to the desired patterns and communication relationships at all other points in the network. Because firewalls introduce transmission latency (delay in transmission) and reduce network throughput, the use of a dedicated firewall may not be feasible

throughout all parts of the network. Instead, internal network protection comes from high-quality network switches and routers with powerful stateless filtering rules as further described in the next section. These rules are usually not referred to as firewall rules but rather as access control lists (ACL). ACLs are suited for any situation where rapid filtering must take place within a network.

Differences in filtering

The environment and the placement within the network are not the only factors that determine the requirements of a firewall. Different use cases place different requirements on the filtering mechanisms that are needed. It is important to differentiate how deeply a firewall can observe the communication between different devices. A broad range of solutions is available that covers this aspect. The available spectrum ranges from firewalls that can only perform simple pattern recognition on packets (often called signatures) all the way up to firewalls that understand the functions and procedures in industrial protocols and thus can prevent individual communication templates in a targeted manner.

The simultaneous combination of differing security characteristics, like firewall mechanisms for instance, can ensure additional security when implementing Defence in Depth. Once again, the master builders of the Middle Ages provide the inspiration for this concept of diversity in defence mechanisms: in castles and other fortifications, high walls were often combined with other methods of defence, such as moats. Thus, an attacker had to develop a much more sophisticated strategy in order to overcome not only the wall, but also the moat.

In modern communications networks, it is equally advisable to implement diverse firewall mechanisms and combine them with Defence in Depth measures or other security mechanisms. The following filter mechanisms are commonly known.

Stateless firewalls

Communication relationships between devices may be in various phases (states). For example, the communication relationship is usually initiated in a first phase. Active communication is conducted in a second phase and the connection is ended in a third phase. A concrete example of a protocol that uses this procedure is the Transmission Control Protocol (TCP). TCP is often combined with the Internet Protocol (IP) to form TCP/IP. As the name implies, stateless firewalls[1] do not react to the state of a communication connection nor do they differentiate between the various phases. Thus, stateless firewalls only determine which individual devices or applications may communicate with one another but cannot determine whether the participants are conducting the communication according to the normal procedure. In particular, a stateless firewall cannot recognise or prevent any attacks resulting from abnormal protocol behaviour. This puts especially vulnerable industrial devices with minimal self-defence at risk of being hit by, for example, a so-called denial of service attack. Such an attack can be performed by deliberately flooding the communication interface of an industrial device with traffic and overloading it with forged or erroneous communication requests.

Stateful firewalls

In contrast to stateless firewalls, stateful (state-aware) firewalls monitor the communication process of the participants and use this recorded information, such as the initiation or termination of the connection, as the foundation for the packet filtering. Thus, attacks that attempt to communicate over connections that are already established can be recognised and prevented. Equally, attacks that use a known faulty connection in order to load and overload a system can be prevented.

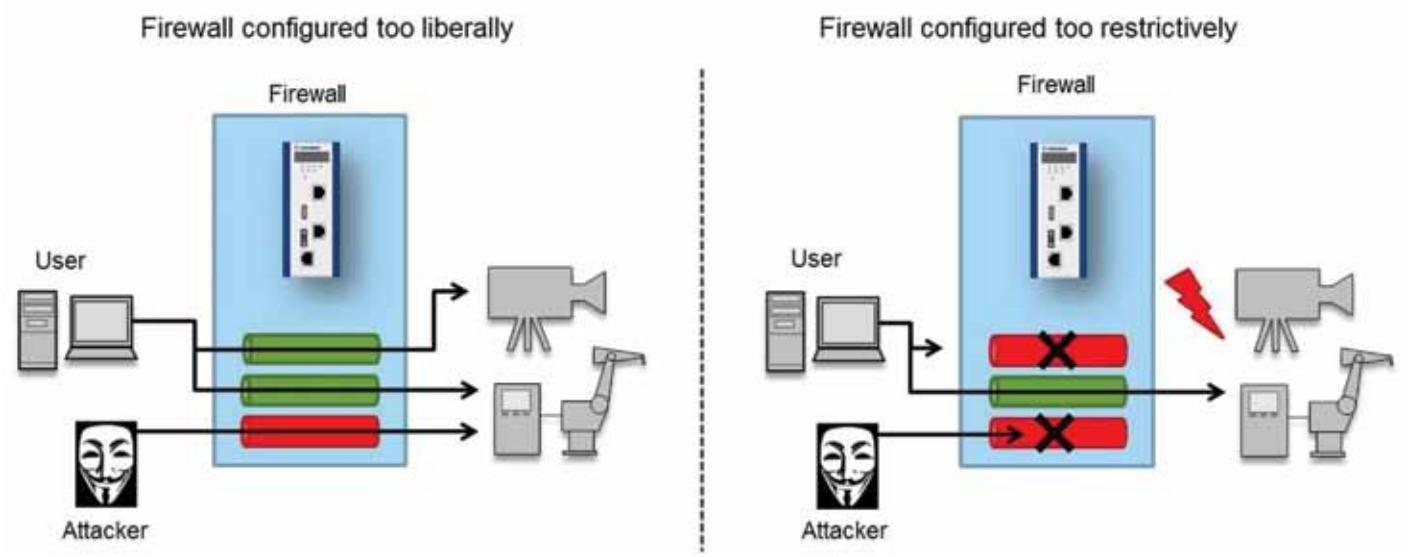


Figure 1: Integrating a firewall into an existing industrial network may lead to too liberally or too restrictively configured rule sets.

Deep packet inspection

Deep packet inspection (DPI)[1] is an extension of stateful packet inspection. Stateful firewalls normally only examine the header at the beginning of the packet because the header contains all the information needed for the firewall to determine and monitor the communication state such as sequence numbers and the communication flags used by TCP. Deep packet inspection goes one step further and allows examination beyond the communication header all the way to the payload of a packet (eg, the control protocols of the industrial applications). In this way, highly specialised attack patterns that are hidden deep in the communication flow can be discovered.

To do this, the firewall must be capable of interpreting the respective communication protocol in order to differentiate between a well-formed, 'good' packet and a malicious packet or harmful payload. Therefore, deep packet inspection firewalls are often implemented as additional components of a stateful packet inspection firewall and only for select protocols and application purposes, such as industrial protocols.

A deep packet inspection firewall offers a high degree of security, often with a rule set that can be highly individualised and finely configured, but it demands more computing power. Equally necessary is a specialised configuration interface for establishing the firewall rules. Fortunately, leading products have built-in tools, making this process straightforward.

Because of their ability to provide very granular protection for not only which devices communicate with one another but also the ability to understand control protocols and allow only certain types of communications, deep packet inspection firewalls are well suited to secure the conduits between various industrial zones. By carefully deploying them at select points within the network they can significantly harden industrial communications.

Sometimes, the term "deep packet inspection" is used when describing a very different security mechanism that is implemented using a signature database rather than by fully decoding the application protocol. Signature files provide a very different type of protection. Signature files match the bits with a packet to a set of signatures to identify and block a set of previously identified vulnerabilities. So, while signature files can protect against known vulnerabilities, they do not provide the broad protection against malformed packets that protocol-level DPI provides, nor do they allow the message flow to be tightly configured to only allow messages that make sense in the operation of our specific system.

Management of firewalls

Just as there are differences in the application areas and the capabilities of the packet filter, there are differences in the additional functions of firewalls. An easy-to-use firewall can be the difference between a solution that is feasible for use or a solution that is more of an obstacle than an enabler in the implementation of a security strategy. This can be demonstrated by reviewing two typical management tasks: a) the integration of a new firewall in an existing industrial network and b) the management of multiple firewalls with network management tools.

Learning firewalls

Deploying a new firewall in an existing industrial network is no trivial matter. In such an application, there are generally numerous communication relationships that are only completely and correctly summarised and documented in the rarest of cases. Since the main function of a firewall is the prevention of unknown network traffic, the initial configuration of these devices is especially difficult.

If the firewall is configured too liberally, the control and monitoring traffic of the facility can flow without problems; however, the firewall also presents no great obstacle to an attacker or protection against misbehaving devices or malware.

If the firewall is configured too restrictively, it blocks the communication of a potential attacker, but it also hinders regular traffic so that the facility no longer operates faultlessly in all situations. This can lead to delays and costly repairs.

It is therefore important to configure the firewall properly in order to permit desired communication while simultaneously preventing undesired traffic. Without a complete view of all communication relationships, the integration of a firewall into an existing network can be a nerve-wracking situation (see Figure 1).

Modern, high-quality industrial firewalls support employees during commissioning by offering special analysis modes. Such a

> WITH PROPER MANAGEMENT TOOLS, STANDARD CONFIGURATIONS CAN BE IMPLEMENTED QUICKLY ON NEWLY INSTALLED FIREWALLS, AND MASS CONFIGURATION CHANGES CAN LIKEWISE BE MADE TO ADAPT TO NETWORK INFRASTRUCTURE CHANGES.

mode (eg, a Firewall Learning or Test Mode) enables the firewall to analyse the communication relationships in a network during a learning phase. During this learning phase, the firewall records all communication relationships without restricting any of them. With the help of the connection analysis, an administrator can then detect the desired or undesired communication relationships quickly and easily create a custom configuration of the firewall (semi-)automatically. This saves times and enables a functional and secure configuration without risking downtimes and failures. The duration of the learning period must be freely configurable since the firewall must observe all communication relationships during the learning phase. In particular, in the case of sporadic communication relationships, eg, during regularly scheduled maintenance, the timeframe must be set accordingly to also capture this sporadic communication.

Management of multiple firewalls

The use of firewalls to isolate various devices and facility components from one another is an important aspect of a Defence in Depth strategy. If an attacker has overcome an initial obstacle and penetrated the network, additional firewalls with more specific rules can prevent penetration into additional and more sensitive facility components.

But take note, the use of multiple IP firewalls and transparent Layer 2 firewalls requires management and configuration of these devices. Without a powerful management tool for simple (mass) configuration of firewalls, this task can be very time-consuming and error-prone in the case of changes to the network infrastructure. Hence, it is important that the firewalls can be managed and monitored centrally by network management tools to assist this process.

With proper management tools, standard configurations can be implemented quickly on newly installed firewalls, and mass configuration changes can likewise be made to adapt to network infrastructure changes. An example of such a change would be on a new log server that can be reached by all devices in the production network. If all firewalls must be configured individually, the IP address and the port of the log server must be set on each firewall. This is time-consuming and subject to errors. With mass configuration via a network management tool, this task can be simultaneously and reliably performed for all firewalls at once.

Summary

Even though firewalls are just one of many essential parts in modern security practices, they are still a pivotal element that no security model can do without. For implementing important principles from international standards and best practices, firewalls are absolutely essential to operations.

Firewalls are not a single type of device but rather a diverse collection of devices with differing technical characteristics, hardware features and equipment and regulatory and industry approvals that impact the types of industrial environments they can be used in and the use cases they best serve. It is therefore crucial to choose the correct firewall for each area in the industrial network. To maximise the effectiveness of firewalls, network designs need to follow the rules set forth with the best practices of Zones and Conduits as well as Defence in Depth. By combining different firewall functions in an overall network defence strategy and by positioning the different types of firewalls in the network where they can play to their strengths, it is possible to design networks that are prepared for the future and will stand the test of time.

1. National Institute of Standards and Technology NIST 2011, *Guide to Industrial Control Systems (ICS) Security*.

**Dr Tobias Heer is Senior Architect CTO Office, Hirschmann Automation and Control GmbH, while Dr Oliver Kleineberg is Global CTO Industrial Networking, also at Hirschmann Automation and Control GmbH. Divij Agarwal is Senior Product Manager at Belden.*

Control Logic Pty Ltd
www.controllogic.com.au

©stock.adobe.com/au/kras99

PLUG-AND-PLAY CONVEYOR PLATFORM

Efficient material feed and discharge play a crucial role in realising the productivity potential of manufacturing cells, assembly and packaging stations. At the same time, rapidly changing process environments in many industries require flexible conveyor solutions that can easily adapt to changing requirements.

Designed as a plug-and-play modular system, Interroll's Light Conveyor Platform (LCP) allows system integrators to implement scalable belt conveyor sections easily in order to quickly meet customer-specific automation requirements for material flow.

With the LCP, belt conveyors can be easily assembled from factory-preassembled and predefined modules without any engineering effort, and can be put into operation quickly and safely via an autonomous machine control system, optionally without an additional programmable logic controller (PLC). Depending on user requirements and application, however, connection to an external PLC with user-specific programming is also possible.

Interroll's LCP is designed to transport smaller conveyed goods, as well as boxes or polybags weighing up to 50 kg. The conveyors, which can also handle inclines or declines, are driven by compact and energy-efficient drum motors that have an efficiency of over 85%. The fully modular system can be planned and assembled easily and conveniently on a PC using Interroll's Layouter tool.

The LCP also features an integrated emergency shutdown at the push of a button, complies with all relevant safety regulations and has a quiet noise level during operation.

Interroll Australia

www.interroll.com

CUSTOMISABLE INDUSTRIAL MONITORS

Rockwell Automation has released a line of industrial monitors that are designed to help machine builders differentiate their machines and meet a wide range of application needs. The Allen-Bradley ASEM 6300M industrial monitors, part of the range formerly known as VersaView 6300, offer several design options. These options give machine builders freedom to customise the monitors based on factors like cost, performance, and look and feel.

Key design options include stainless steel models, including IP66K-rated and IP69K-rated options, to meet the needs of users that have washdown requirements, as well as other models to meet different needs, from economical aluminium options to edge-to-edge glass options for sleek, high-end displays.

Single- and multi-touch displays allow machine builders to match the monitors with their preferred software or to a user's operating requirements, while monitor sizes range from 8.4 to 24″ and are available in both standard and widescreen formats. A long-distance option will soon be available, allowing a monitor to be placed up to 100 m from a PC for applications like extended production lines.

All monitors have high-resolution displays that can display up to four tiles of information on a single screen, giving operators not only insights like performance data and work instructions but also high-resolution videos and real-time camera feeds.

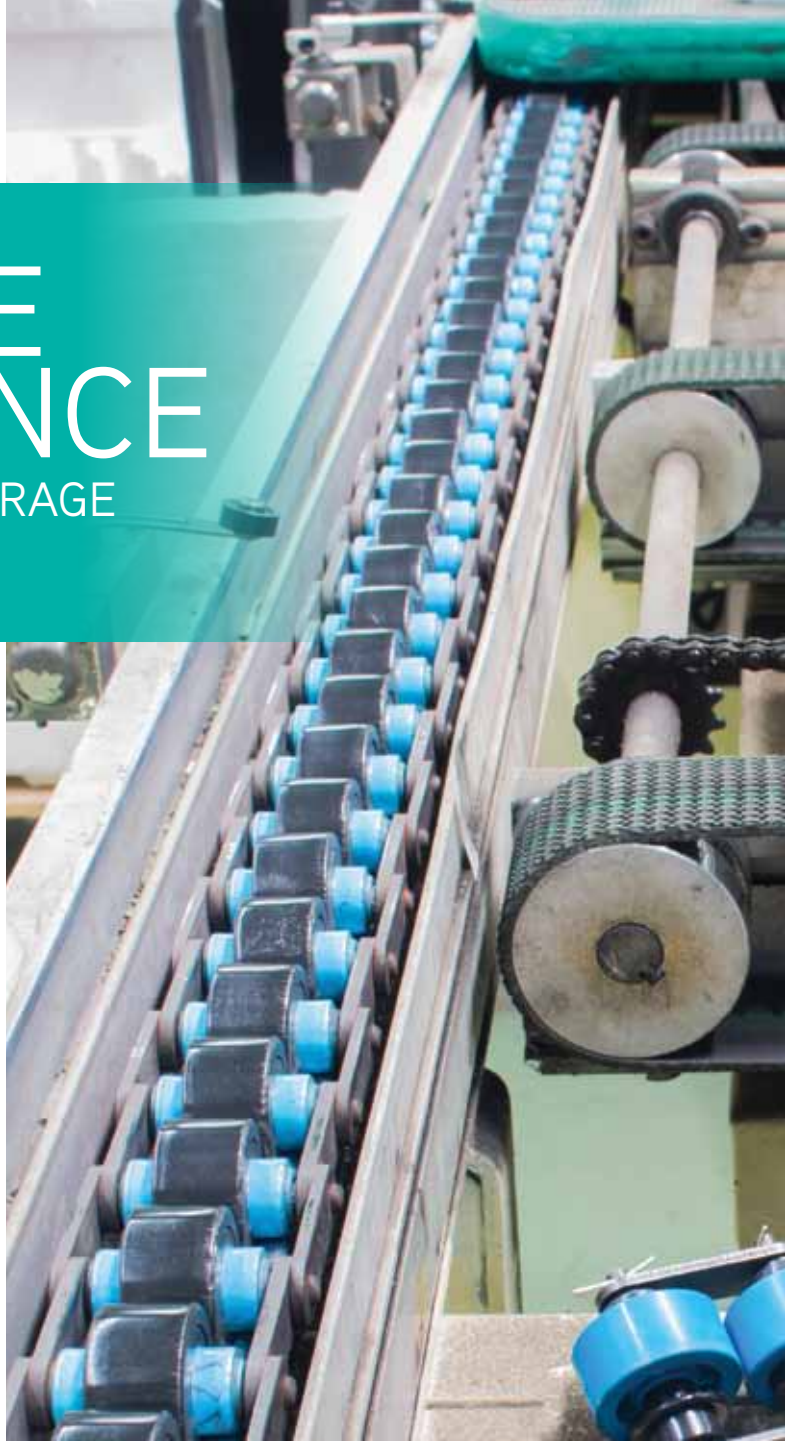
The monitors also provide a standardised cut-out for easy replacement. Whether a machine builder chooses a standard or widescreen monitor, they will be able to upgrade to future versions of that monitor without having to alter their machine design.

Rockwell Automation Australia

www.rockwellautomation.com/en-au.html

PREDICTIVE MAINTENANCE

ALLEVIATES FOOD AND BEVERAGE PRODUCTION CHALLENGES



Food processing and food packaging are uniquely fast-paced environments, where the margin for error is slim to none. Particularly in the tightly regulated world of food and beverage production, a breakdown in the production line can result in a whole batch of products being discarded.

Manufacturers looking to avoid food waste and costly production disruptions have looked to machinery data and predictive maintenance tools as a way to gain greater insight into what is happening on the factory floor, perform essential maintenance when it is required and anticipate and prevent breakages before it is too late.

"Once you give manufacturers involved in food and beverage manufacturing the ability to visualise data, everything changes," said Jim Wallace, Sales Manager at Balluff Australia and member of Industry 4.0 advocacy group Open IIoT. "It gives them greater control over the production process, and once that data visualisation is paired with predictive maintenance, efficiency and revenue gains are realised."

What is predictive maintenance?

This proactive approach uses innovative diagnostic and sensing technologies to monitor the condition of equipment and predict when maintenance should be performed. Predictive maintenance tools such as infrared thermography (detecting high temperatures), acoustic monitoring (detecting leaks), vibration analysis and oil analysis alert manufacturers of potential failures.

"Essentially, predictive maintenance uses data to estimate when a machine might fail (causing costly disruptions) so that maintenance can be scheduled before the point of failure, to reduce downtime," Wallace said. "Another benefit is that it gives manufacturers the ability to schedule maintenance when it is most cost-effective and does not interfere with production, as well as helping to extend the equipment's lifespan."

As food and beverage manufacturing is a tightly regulated industry, the strictest hygiene and sanitation standards must be upheld. The need for heightened cleanliness can create a wet environment, which can easily damage important equipment.

"Add on the fact that machines deployed in the food processing industry are highly complex and challenging to maintain due to the connected system of conveyors, electronic and electrical equipment, and the heightened risk of machinery breakdown becomes abundantly clear," Wallace explained.

Impact of breakages in food and food packaging production

Poor maintenance results in unexpected breakages, and even worse — if a machine has missed multiple maintenance cycles due to a lack of monitoring, it may be broken beyond the point of repair. It has been estimated that unexpected downtime costs manufacturers an estimated US$50 billion annually and reduces plant productivity by 5–20%.

In the food industry, these consequences are magnified. Food processing equipment is working with delicate products that have a variety of time requirements to ensure health and safety standards are met. Any delays in the production process may result in spoiled goods. Broken machines are unsafe and carry the threat of contaminating food and beverages or damaging food packaging. If any contamination or damage occurs, manufacturers will need to dispose of the goods and restart the production process from scratch leading to food waste, missed deadlines and additional costs incurred.

"While predictive maintenance is key to predicting and ultimately avoiding these obstacles, manufacturers in this industry will realise additional benefits when these technologies are combined with data visualisation tools," Wallace said.

Data visualisation the key to remaining competitive

Data visualisation refers to presenting data in a visual context such as a chart or graph so that it can be more easily understood. In

food and beverage production, this is made possible by adding sensors to machinery to monitor what is going on at the factory floor. By using IoT connectivity, this information is shared as data that manufacturers can access in real time and use to make decisions.

"Using sensors to transmit real-time data can alert employees when equipment malfunctions so that they can make the necessary adjustments to avoid goods from becoming contaminated or destroyed," said Richard Roberts, Industry 4.0 Operations Manager at ZI-Argus and fellow member of Open IIoT. "Data insights allow employees to adjust equipment in real time to get it back to normal functionality, reducing the need to shut down production completely."

In the food and beverage industry, where contamination is always a risk, data-driven insights have further advantages. If there are reports of consumers getting sick from products, manufacturers can check machinery data to trace back through the food production line and determine the source of the contaminants. This gives them the facts necessary to decide whether or not a product should be recalled.

Combining predictive maintenance with data visualisation helps to boost equipment reliability, quality standards and production.

What's holding manufacturers back?

With all of these benefits, why is predictive maintenance not more widely adopted by food and beverage manufacturers?

"Compared to other manufacturing industries, the food and beverage sector has historically been a late adopter of digital trends," Roberts explained. "This is often because of the complex manufacturing processes needed to comply with the strict safety and hygiene standards of this industry, which may result in manufacturers being more hesitant to adopt new solutions."

The initial cost of implementing predictive maintenance and related Industry 4.0 technologies on the factory floor is a factor, but Roberts reassures manufacturers that these tools have not only become much more affordable in recent years, but that they will soon pay for themselves in gains realised.

"Predictive maintenance is a cost-effective strategy as it reduces downtime and helps prevent food waste," he said. "Smart connected systems give food and beverage manufacturers a competitive advantage, boost product quality and safety, increase efficiencies and increase productivity — there is very little to lose by implementing them."

Open IIoT
www.openiiot.com.au

CLAMP-ON FLOWMETER

The OPTISONIC 6300 series of ultrasonic clamp-on flowmeters has been updated with the latest version of the portable clamp-on OPTISONIC 6300 P, which now catches up with its stationary counterpart OPTISONIC 6300 in terms of functionality.

The updated OPTISONIC 6300 P comes with a battery-powered field converter with full measurement functionality including thermal energy calculation and an integrated data logger. While signal processing and measurement signals have been improved significantly for the new version, all measurement data can now also be monitored and analysed via a smart device using the OPTISONIC 6300 P mobile app for Android. The app makes it easy to set up and commission the clamp-on flowmeter via secure wireless Bluetooth connection or USB cable.

The portable sensor rail of the OPTISONIC 6300 P has also been redesigned and can be supplied with large transducers as an option. It can therefore now be used in all liquid applications in pipelines with diameter ranges from DN15 to DN4000, the same range as the OPTISONIC 6300 stationary clamp-on flowmeter.

KROHNE Australia Pty Ltd
www.krohne.com.au

ETHERNET SWITCH FOR HAZARDOUS AREAS

Pepperl+Fuchs has announced the FieldConnex Ethernet-APL Rail Field Switch for DIN rail mounting that enables direct and barrier-free access to and from the field devices of process plants via Ethernet-APL.

The Ethernet-APL field switch has been designed with intrinsic safety explosion protection, Ex ic IIC, which allows Ethernet in hazardous areas of Zone 2 and Division 2. In addition, the company says it is the only switch in the world that supports the Manchester Bus-powered Physical Layer (MBP) alongside Ethernet-APL and can therefore be easily added to the existing base of Profibus PA devices.

The Ethernet-APL rail field switch makes it possible to operate existing and new field devices at the same time via a common infrastructure. Old and new technologies are used in parallel, which not only protects the investment in existing equipment technology, but individual measuring points can be equipped with new functions or quick communication in a targeted manner, if required.

The Ethernet-APL rail field switch features integrated diagnostics for the physical layer and is designed for star topologies typically used in compact or indoor installations. It has the following features and meets the requirements of cable lengths of up to 200 m to the field device, indoor installations such as in the chemical and pharmaceutical industry, installation of the switches in switch cabinets or junction boxes, Ethernet redundancy at the plant level and explosion protection for all hazardous areas.

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

LUBRICATION-FREE LINEAR BEARINGS

The drylin linear bearings enable maintenance-free and lubrication-free operation of parts of machines and equipment whose function is determined by relative movements in a straight line between components. The dry-tech high-performance plastics of the bearing bushings allow machine elements to be moved along a shaft or profile guide silently and with little friction.

Compared to linear solutions with rolling elements, the acquisition costs are up to 40% lower and there are no additional operating costs. In linear ball bearings, one or several rows of balls support the shaft. To work properly, they need a ball recirculation system that guides the balls back in the direction opposite to the shaft's direction of movement. The ball recirculation system and the high level of stress on the balls due to the load being applied to a small point on each ball are factors that result in potential weak spots and noise. Recirculating ball systems can be replaced with igus linear bearings of the drylin series in nearly all areas of use.

Due to their simple structure, the drylin linear plain bearings are said to have very little susceptibility to failure. Lubrication-free operation means that the machine parts remain free of dirt, dust and moisture.

Treotham Automation Pty Ltd
www.treotham.com.au

COMPRESSED AIR FILTERS

Kaeser Compressors has launched an updated generation of compressed air filters that it says provide highly efficient filtration for flow rates from 0.6 to 32.0 m^3/min.

The efficiency of a compressed air filter depends most on pressure loss, with every 1 bar of pressure loss increasing a user's energy cost by 6% per m^3/min of compressed air. Kaeser says its filters deliver a 50% lower pressure loss and that it remains constant throughout the entire service life of the filter element. As a result significant cost reductions and reduced CO_2 emissions are made possible.

Kaeser filters use filter elements with flow-optimised element heads. The filter inlet is offset towards the air inlet, which increases the flow cross-section at the air discharge side and contributes to higher filter efficiency with minimal pressure loss. Generously dimensioned connection flanges also help to keep pressure losses to a minimum.

High filtering efficiency with minimal pressure loss is also assisted by the element head of the filter, which is optimised for best possible air flow. Its tapered internal structure channels the compressed air towards the centre of the element interior for an even charging of the filter media.

In addition, deep pleated particulate and coalescence filter elements feature large filter surfaces, further increasing efficiency.

Kaeser Compressors Australia
au.kaeser.com

ENERGY SAVING AIR COMPRESSORS MEET FOOD STANDARDS REQUIREMENTS

The generation and application of clean, food grade compressed air is a vital part of most manufacturing and handling processes. It is even more critical in the food processing industry where the slightest contamination can be a very expensive and disruptive problem.

New PMV (Permanent Magnet Variable Frequency) rotary screw air compressors utilise special FDA-certified food grade, synthetic lubricants to eliminate the chance of contamination through the compressed air plant and line to deliver clean, dry air power at the application end.

Developed by Kaishan, these new age compressors are also the best choice for food manufacturers wanting to reduce the cost of compressed air generation with a highly reliable and low maintenance machine.

Kaishan's revolutionary range of Permanent Magnet Rotary Screw Compressors deliver up to 50% energy cost savings over conventional compressors with equal or greater output.

From 250 kW to 15 kW, these advanced machines utilise systematic optimisation of the airends through permanent magnet drive motors and variable speed drive technology to achieve higher efficiency at all operating speeds. This also results in far greater bearing life and long term, trouble free operation.

The combination of advanced PMV 2-stage technology and variable speed control means the system only operates at the level required to generate air for a given application at any time from stop to maximum output. This controlled flexibility is ideal for food processors with variable needs in compressed air power for a variety of manufacturing, processing, packaging and handling operations.

Kaishan Compressors have a vast experience in providing food-grade air compressors and systems for use in processing, conveying, packaging and other operations. Custom designed and made compressors include marine-based machines for aquaculture and specialised models for grower quality control lines.

A leading Australian egg brand has recently installed a Kaishan 75 kW PMV compressor to run their processing, grading and packaging facilities ensuring efficient, contaminant-free operation with considerable energy cost savings over the replaced, fixed speed machine that had failed.

Every Kaishan compressor is fully supported by custom service plans and 24/7 mobile service technicians that ensure the compressors and systems run at peak efficiency day in day out.

KAISHAN

Kaishan Australia Pty Ltd
www.kaishan.com.au | 1300 098 901

PANEL PCs, THIN CLIENTS AND MONITORS

Available through NHP, the ASEM 6300 line of industrial PCs, thin clients and monitors from Rockwell Automation is designed to help optimise operations. Industrial ASEM 6300 PCs and thin clients combine with FactoryTalk View human machine interface (HMI) software and ThinManager thin client management software to create a complete visualisation system.

The ASEM 6300P Panel PCs are based on the seventh generation Core i3, i5 and i7 Intel Kaby Lake H and Intel Celeron Skylake processors to handle complex industrial applications. Touch screen technologies, which enhance ease of use, include analog resistive and projected capacitive (for multitouch operation), and they are available in a variety of display sizes and resolutions.

ASEM 6300T Thin Clients feature Intel Apollo Lake Atom processors, making them suitable for HMI, IIoT gateway and data logging applications. Atom class units are also available as ThinManager-ready thin clients to boot natively into ThinManager software with no solid-state drive (SSD) on board. These units have a fanless design making them optimal for applications requiring low maintenance, as well as multiple mounting methods to fit application needs.

The ASEM 6300M industrial monitors offer several design options that give machine builders freedom to customise the monitors based on factors like cost, performance, and look and feel. Key design options include stainless steel models, including IP66K-rated and IP69K-rated options, to meet the needs of users that have washdown requirements, as well as other models to meet different needs, from economical aluminium options to edge-to-edge glass options for sleek, high-end displays.

NHP Electrical Engineering Products Pty Ltd
www.nhp.com.au

Research project improves efficiency in industrial manufacturing

Across the world many manufacturing companies use large fleets of equipment and complex production facilities. Modern machines fitted with an extensive range of sensors supply an increasing amount of data, resulting in huge optimisation potential for production by means of data analysis using artificial intelligence (AI) and machine learning (ML). A consortium comprising several Fraunhofer institutes has been seeking to harness this previously untapped potential for the benefit of the industry.

As part of the four-year lighthouse project "ML4P — Machine Learning for Production" lead by the Fraunhofer Institute of Optronics, System Technologies and Image Exploitation IOSB, the consortium has created an efficient solution based on ML technologies that companies can use to optimise their production processes. ML4P uses a combined approach consisting of a scientifically based process model and software tools derived from this. The objective is to make production faster and more energy- and resource-efficient. The ML-based software suite can, for example, analyse machine data to discover hidden contexts and use these to optimise the manufacturing process. It is also capable of improving production on an ongoing basis thanks to its ability to learn. This is also beneficial for the quality of products.

However, the software is only one part of the ML4P approach — its process model acts as a key foundation.

"We don't just pop up with a completed software solution for a company — instead, we guide them through the process model, taking a methodical, step-by-step approach," said Christian Frey, Head of Systems for Measurement, Control and Diagnosis at Fraunhofer IOSB and ML4P project manager.

The first step is to analyse the current state of the production process. Based on the results, the experts identify potential areas for optimisation, set targets and develop a concept for implementing ML4P. In the next step, they examine whether the concept can actually be implemented with the available machinery and their data, and also how it lines up with the company's objectives.

"The process model is divided into several phases that build upon one another. The decision as to whether a company actually opts for ML4P will only be taken when it is certain that the concept is viable, is easy to implement and economically reasonable," said Lars Wessels, ML4P deputy project manager.

The following step involves transforming process data from the machinery into a comprehensive, digital information model. In this process, expert knowledge is just as important as the data. Engineers are actively involved and contribute their knowledge about all steps of the process, including the specific tasks and interactions of the machines. The expert knowledge is integrated into the ML4P pipeline, which learns a process model from machine data. Implementation and test operations follow afterwards. Eventually, the process model is deployed and daily production begins.

The software suite offers a range of tools for implementing ML-optimised production, including generic tools for typical tasks such as monitoring a machine's operating state. These are compatible with a number of industrial communication interfaces such as OPC UA. Wherever possible, Fraunhofer researchers tried to avoid using proprietary software protocols, relying instead on established standards and programming interfaces.

Other strengths of this concept are its scalability and flexibility. Once put into operation, each module can be customised at any time and use the incoming new data to continuously update the process model and thus point out potential for further optimisation. New machinery can be integrated as can most older machines — even those that are 30 or 40 years old.

"It is not so much about the machine, but whether it can provide suitable data, for example if it is equipped with dedicated sensors," Wessels said. Smaller companies can also apply ML4P, even if they only want to optimise specific parts of a manufacturing process.

"Many companies are still sceptical about the use of artificial intelligence or ML because they have not yet recognised the enormous potential that machine learning offers for production. However, the modular platform from Fraunhofer provides transparency, flexibility and scalability, thus reducing the barrier to entry," Frey said.

The ML4P team has already tested the integrated concept across various fields of application. Solutions for hot sheet metal forming were developed at the Fraunhofer Institute for Machine Tools and Forming Technology IWU. The Fraunhofer Institute for Factory Operation and Automation IFF has optimised the production of membrane filters and the Fraunhofer Institute for Mechanics of Materials IWM has tested the software suite at a glass-bending plant. The software tools were continuously improved based on the experience gained during these field tests.

"We are very happy that the ambitious ML4P project has been successfully completed after four years of work," Frey said. "For the first time, companies in the manufacturing industry have the opportunity to experience the full optimisation potential that machine learning can bring to production."

Fraunhofer Institute of Optronics, System Technologies and Image Exploitation IOSB
www.iosb.fraunhofer.de/en.html

VALVE ACTUATORS

Rotork has announced that its CK range of modular electric valve actuators has been extended to include a part-turn variant, known as the CKQ. The entire range has a modular design that provides flexibility and high degrees of configurability, enabling a fast order turnaround and quick delivery. CK actuators provide flow control in non-hazardous locations and are especially suited to diverse applications in the water and power markets.

The CKQ part-turn variant is suitable for harsh and demanding environments and has an operational temperature range of -30 to +70°C. The IP68 enclosure protection is maintained even when the actuator terminal housing is removed by using a double-sealing system around both parts of the plug and socket connection. This contributes to its suitability for use within the water market. Continuous mechanical valve position indication is provided (even without power) and the CKQ provides up to 60 starts/h at a rate up to 1 start every 6 s. All options within the CK range provide oil bath lubrication for extended life and mounting in any orientation, and motor-independent handwheel operation is available.

The modular structure of actuators in the CK range means a wide variety of options and features are available. This includes the CK Standard actuator, the Centronik (for intelligent, integral control) and the Atronik option for intermediate modest control.

Rotork Australia
www.rotork.com

POINT CLOUD CAMERAS

The SmartRunner Explorer 3-D by Pepperl+Fuchs can be used to create 3D point cloud images, which the company says provide an accurate representation of objects. The different sensor versions are available with stereo vision or time-of-flight technology (ToF) and can be used in a wide variety of applications — for goods inspection on conveyor belts or pick-and-place applications in robotics.

Since they are equipped with an integrated FPGA, the measurement data is processed directly in the sensor. This means that the 3D data is provided immediately and does not have to be calculated externally. The images from two offset cameras are automatically superimposed and merged into a 3D point cloud using a semi-global block-matching process. An infrared pattern of 72,000 points enables both images to be exactly superimposed for maximum precision. In addition, the operator can access live images and use them for quick and easy commissioning as well as error analysis.

If required, the images can also be recorded with integrated lighting. With a resolution of 1.4 Mp and a range of 1 m, the SmartRunner Explorer 3-D with stereo vision technology is optimised for high-precision detection of objects at close range.

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

THE LIGHTS-SPARSE VERSUS THE LIGHTS-OUT FACTORY

PART 2

The opportunities presented by the concept of a 'lights-out' factory — one in which the requirements for human activity are so minimal that the facility can operate in the dark — was discussed in Part 1 of this article, along with some of the enabling physical technologies available today to make it potentially possible. But there are many challenges still to be overcome, from the emerging need for product customisation and varying labour and skills issues across the world, to entrenched mindsets.

In the end, it will be the ongoing increase in digitalisation and advanced software that will make possible lights-out — or at least lights-sparse — manufacturing.

Competing interests

While modern technological developments may accelerate the implementation of lights-out manufacturing, other recent trends and perennial market conditions make lights-out implementation more challenging. This is especially true for brownfield factories, where design and implementation of lights-out operations are complicated by the necessary transition from existing manufacturing approaches. Greenfield factories, on the other hand, can leverage technologies right away to prepare the facility for the challenges listed below, building the facility with factory floor modularisation, automation, 5G, AI/ML, other enabling digital technologies and a data-driven mindset.

Design anywhere, build everywhere is the latest mantra associated with the trend towards manufacturing globalisation. By making deliberate choices about where and when to run production, manufacturers expect to reduce manufacturing costs and accelerate time to market. They want to make production decisions based on location, on-site material inventory, machine capacity, skilled labour availability, shipping requirements — any parameter that impacts timely, efficient and cost-effective production. For these global manufacturing enterprises, lights-out manufacturing adds a dimension of complexity to any design anywhere, build everywhere decision matrix.

If a lights-out or lights-sparse factory is one of the build everywhere options, for example, considerations regarding skilled labour may be replaced with those regarding the manufacturing equipment's capabilities for autonomous operations, as well as the equipment's or work cell's ability to self-configure or reconfigure based on the product variant to be produced. Additionally, even if a dark factory, or lights-out operation within a conventional factory, is capable of carrying out a particular production run at a lower operational cost than a fully conventional factory, does that location have access to needed resources? Digital tools are essential not only for the planning and scheduling decisions to be made in such circumstances, but also for communication of design, supply, production engineering, quality requirements and inspection/test mechanisms and feedback of production information.

Mass customisation and individualised production are growing requirements across nearly every manufacturing sector, from specialty food and beverage items to new automobiles. Consumers want individualised products, but at the prices they would pay for mass-produced goods. To keep up with these demands, manufacturers must accommodate short innovation cycles with more complex products, and as a consequence, they need to more closely integrate modelling, engineering and simulation with manufacturing production. This means that the manufacturing floor must be more flexible than ever before — but lights-out manufacturing operations are more suited to long, steady production runs of the same product.

Ultimately, lights-out manufacturing and flexible manufacturing are not mutually exclusive; in fact, digital manufacturing tools available today are capable of addressing the need for flexibility and realising lights-out where it is feasible. Until a manufacturer has outfitted a factory with modular production equipment able to reconfigure itself, however, these digital tools will have to treat mass customisation and lights-out manufacturing as competing interests.

Trade-offs between labour and automation also directly confront manufacturers considering lights-out manufacturing. Generally, humans are flexible but more error-prone and slower, while automation is less flexible but faster and less error-prone. With the design anywhere, build everywhere and mass customisation

Figure 1: Digital tools are essential to lights-out manufacturing.

trends described above, flexibility may be the factor for manufacturers deciding between lights-out and conventional operations. Again, digital systems for manufacturing engineering can facilitate such decision-making today with tools such as plant and process simulations.

Entrenched mindsets and human inertia may also keep some manufacturers from initiating moves towards lights-out manufacturing. According to the Gartner study mentioned in Part 1, advancements in technology will make lights-out production processes a reality in 2025. But the lights-out smart factories must balance between augmented and automated processes, organisational and technical challenges. For manufacturers with the foresight to explore and prepare for lights-out manufacturing, there is an opportunity for a powerful competitive advantage.

The path to lights-out manufacturing traverses every point of product life

How does a forward-thinking manufacturer prepare for lights-out manufacturing? What are the prerequisites? Once a decision to invest in lights-out or lights-sparse operations has been made, the key to implementation is how a company will leverage digital manufacturing tools to support crewless areas of the shop floor. Implementation of lights-out manufacturing, as discussed, can be undertaken incrementally, with certain operations or certain time periods of a production run targeted, one at a time, for crewless operation.

For example, in many complex manufacturing operations, inspection of work-in-progress is often performed manually by human inspectors. This may be true even when manufacturing value-added operations are highly automated, and this makes manual inspection a bottleneck against productivity gains. Alternatively, automated inspection is a type of lights-out or lights-sparse undertaking. The inspection system captures data or images of as-built features (or anomalies) and analyses it, referring to design data as the standard. When non-conformances occur, a lights-sparse operation might send an alert to a human operator for corrective action; a lights-out inspection system would include automated resolution of non-conformances. Beyond this detection/correction activity, automatic inspection data may be analysed to generate manufacturing intelligence that feeds continuous improvement efforts. When embedded with AI/ML-based algorithms, an unsupervised and supervised learning mechanism can be built to create possibilities for needed self-resolution/prescriptions.

Preparation for each lights-out manufacturing operation within a production facility must include the closing of gaps between virtual and real production, between the digital and physical factory. After all, without human intervention, production machines will take only those actions they are programmed or digitally directed to take. To realise lights-out manufacturing, then, manufacturers must consider how the virtual and real worlds will interact throughout a product lifecycle.

When actual operations are no longer attended by human operators, digital tools must provide manufacturing overseers with full, interactive visibility into each lights-out function. Visibility is achieved by orchestrating operations and collecting critical data to implement needed integration for lights-out operations. Simple products made on one or two machines require relatively uncomplicated communication from design to manufacture; but complex products involving multiple operations and machines require integration from orders to scheduling to production and delivery. Additionally, digital tools must enable dynamic responses either to changes in the supply chain or to upstream change management, along with seamless virtual validation for flawless lights-out production.

And then there is the question of efficiency: the ideal is for each machine to remain busy. To achieve this level of efficiency when one or several production steps will take place without human intervention, the digital manufacturing processes account for different time requirements of different operations, the need to minimise process changeovers, complex coordination of material movement and many other factors that are closely tied to the automation layer. By anticipating and addressing these issues digitally, lights-out operations replace human flexibility and spontaneous responsiveness with data-driven manufacturing. That is, digital systems provide real-time data insights that are fully correlated across processes, enabling automated predictive and prescriptive responses.

The digital twin: the workhorse of lights-out manufacturing

Central to the digital tools that facilitate lights-out and lights-sparse operations is the digital twin, which is the virtual rep-

> ULTIMATELY, LIGHTS-OUT MANUFACTURING AND FLEXIBLE MANUFACTURING ARE NOT MUTUALLY EXCLUSIVE; IN FACT, DIGITAL MANUFACTURING TOOLS AVAILABLE TODAY ARE CAPABLE OF ADDRESSING THE NEED FOR FLEXIBILITY AND REALISING LIGHTS-OUT WHERE IT IS FEASIBLE.

resentation of a physical product and associated processes, from conception through lifetime product performance in the hands of the end user.

Visibility of the digital twin is provided by a data infrastructure known as the digital thread and its continuity along the value chain. The digital twin provides the format into which design, engineering, manufacturing and field data are organised in coherent, accessible and useful models; and the digital thread (once fully built out) creates a collaborative, connected information conduit across product design, production engineering, manufacturing execution, automation and data-driven intelligence.

A comprehensive digital twin captures the full product life and is needed for fully automated production in a dark factory, but more specific types of digital twins are key to the incremental implementation of lights-out manufacturing operations. There are four key types of digital twins for manufacturing operations: the digital twins of product, production facility, production and performance. As a precise digital model, each digital twin displays development through the entire lifecycle and allows manufacturers to predict behaviour, optimise performance and implement insights from design and production experiences.

- The **digital twin for product** provides the virtual-physical connection that helps manufacturers analyse how a product performs under various conditions and make adjustments in the virtual world to ensure that the physical product will perform as planned.
- The **digital twin for production facility** helps manufacturing engineers and planners navigate through the facility in digital representations and visualisations.
- The **digital twin for production** helps manufacturers address the process engineering changes needed to accomplish lights-out operations.
- The **digital twin for performance** helps provide timely insights from lights-out processes that can be used in advanced analytics for data-driven orchestration of ongoing lights-out activities.

With the comprehensive digital twin, manufacturers gain foresight by simulating product, people, processes and resources in the virtual realm before implementing production on the manufacturing floor — a key first step in their journey towards lights-sparse processes. They gain additional insights by matching real-world to predicted performance, and they can use those insights to drive continuous improvements. While the digital twin is advantageous in any manufacturing environment, it is essential to lights-out manufacturing.

Digital tools are essential to lights-out operations

Digital enterprise software solutions are the means by which the digital twin and the digital thread are created, accessed and utilised to implement manufacturing operations of all kinds, including lights-out operations.

Within the digital enterprise, the central support of lights-out and lights-sparse manufacturing endeavours is provided by a digital manufacturing solution, including manufacturing engineering (with simulations), virtual commissioning and manufacturing operations management (MOM) software. Digital manufacturing software serves as the bridge from the virtual world of product ideas, computer-aided design (CAD) and planning to the real world of production. It is the basis for digital continuity between innovative product designs and best-in-class product and production performance. These digital tools ensure that quality and efficiency are built into the manufacturing process and are proactively and systematically enforced.

Just as manufacturers may approach lights-out manufacturing on an incremental basis, the same is true of their implementation of digital manufacturing. Manufacturers can employ digital manufacturing subsystems to implement the digital twin and the digital thread in a modular, stepwise fashion, with ongoing returns on investment that support the next module or step. From their current level of digitalisation, manufacturers can incrementally integrate legacy and custom functionality systems.

Digital solutions will usher in new capabilities in lights-out and other future factories

Today's digital technology is capable of orchestrating lights-out manufacturing processes, work cells and production shifts. The move to greater lights-out implementation, and, ultimately, the widespread growth of full lights-out factories, seems likely to take place through a slow evolution of manufacturing approaches — but the technologies enabling this move are already on the horizon. A marriage of digital and physical manufacturing technologies will enable increasing flexibility, to a point in the future where lights-out factories are able to accommodate mass customisation and design anywhere, build everywhere manufacturing approaches.

Two key developments will open the door to this growth: modular automation and the ability to self-configure at a plant-wide level.

Conclusion

As digitalisation follows automation into the Fourth Industrial Revolution, concepts like lights-out manufacturing will be realised. These developments are not a mere fulfilment of some sci-fi vision of the future from the past century. Instead, they are the outcome of collaborative efforts among manufacturers, automation specialists and digitalisation software suppliers seeking to achieve the perennial goal of manufacturing: an increase of productivity, efficiency, speed and quality, resulting in higher competitiveness for companies on their way to the future of industry.

Siemens Ltd
www.siemens.com.au

NEW PRODUCTS

RUGGED EMBEDDED COMPUTER

The Neousys Nuvo-9000 series is a rugged embedded computer based on the latest and most powerful Intel 12th-Gen Alder Lake platform. The latest Core desktop processor comes with up to 16 cores and 24 threads and presents a boost of computational performance. Combining the increase of DDR5 memory bandwidth and PCIe Gen4 NVMe high-speed disk read/write, users can expect an overall system performance improvement of up to 1.8x when compared to previous 10th- or 11th-Gen platforms.

The Nuvo-9000 series accompanies an expansion Cassette design to provide higher versatility by allowing additional installation of PCIe or PCI add-on cards. Likewise, I/O functions are also enhanced. In addition to six gigabit Ethernet ports with the PoE+ PSE option, the Nuvo-9000 series features a USB 3.2 Gen2x2 type-C port offering 20 Gbps bandwidth for data exchange with external devices, plus another six USB 3.2 Gen2x1 type-A ports for USB3 camera connectivity. It also has an upgraded M.2 Gen4x4 slot to support the latest NVMe SSD to boost disk read/write speed up to 7000 MB/s.

With its thermal design supporting -25 to 70°C fanless operation, significant CPU and I/O upgrades, and multiple expansion methods, the Neousys Nuvo-9000 series is suitable for applications requiring ruggedness, performance and versatility.

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

STATIC ELIMINATION AIR GUN

EXAIR's Intellistat Ion Air Gun is a handheld and lightweight solution to static elimination in clean processes or sensitive assembly work such as scientific and electronic test facilities, laboratories and clean rooms. The Intellistat is designed to consume minimal compressed air while simultaneously delivering precise blow-off and high static decay rates capable of reducing 1000 V to less than 100 V in under 1 s at a distance of up to 600 mm.

The Intellistat is activated with a comfortable, ergonomic short throw trigger that requires minimal effort. The efficient, low-voltage transformer converts 120 V to 24 V to ensure user safety, while also utilising an EXAIR-engineered air nozzle to maximise efficiency and meet OSHA requirements for sound level and dead-end pressure. It is equipped with a red/green LED to signify proper functionality, as well as a hook for easy hanging and storage. The Intellistat's static-dissipative polycarbonate construction assists its usefulness in applications requiring non-conductivity such as circuit board or electronics manufacturing or testing. It produces clean, ionised compressed air essential for removing dust, static or particulate contaminates in sterile environments such as laboratories, clean rooms or scientific testing.

UL listed and CE compliant, the Intellistat is a low-maintenance solution that is an addition to EXAIR's entire Gen4 static eliminator product line including Super Ion Air Knives, Ion Air Cannons, Ion Air Guns, Ionizing Bars and Ionizing Points.

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

ROBOTIC DEPALLETISING SOLUTION

ABB has launched its ABB Robotic Depalletizer, a solution for handling complex depalletising tasks in the logistics, e-commerce, healthcare and consumer packaged goods industries. Using machine vision software, the solution can quickly assess a wide variety of box types, enabling users to efficiently process assorted loads with very little engineering effort and short set-up time.

The robotic depalletiser software uses the information gathered by vision sensor to provide the robot with a suitable grasping point for each box. The robot then picks up the box — weighing up to 30 kg — and places it on either another pallet or an outfeed conveyor. The speed and accuracy of the system enables it to work at a peak rate of up to 650 cycles/h, 24 hours a day.

The vision sensor enables the robot to detect specific carton boxes on pallets, allowing reliable depalletising of several different load types. These include pallets comprising a single type of box in defined layers; 'rainbow' pallets containing a number of different box types; and mixed pallets, which have a wide range of boxes with varying weights, shapes and materials.

The solution can be supplied with a range of four- and six-axis robots to provide the flexibility required to perform either simple or more complex depalletising tasks. ABB's RobotStudio digital twin software is also available, allowing users to build bespoke application simulations with their own box dimensions, weights and pallet patterns.

ABB Australia Pty Ltd
www.abbaustralia.com.au

IIoT ENCLOSURES

IIoT sensor technologies require robust enclosures to meet the diverse needs of the smart factory. OKW Gehäusesysteme is offering suitable enclosure solutions for such applications.

IIoT devices are equipped with sensitive, precise electronics, which places demands on the enclosures they are housed in. The plastic enclosures as well as the aluminium enclosures must be robust and properly sealed, preferably in different sizes and versions, with a wide range of accessories.

Many enclosure ranges can be equipped with an optional seal to ensure a high degree of protection (up to IP 65). This offers the electronics optimum protection from dust, dirt and splash water. This makes the enclosure suitable for applications in harsh industrial environments. The material also plays an important part, which is why numerous enclosures are available in materials with high levels of UV protection.

The installation of the units offers different approaches, depending on the type of enclosure. The EASYTEC flanged enclosure and the large-volume NET-BOX are suitable for stationary use with wall mounting or inside machines or systems. The PROTEC and the SMART-TERMINAL aluminium profile enclosures are available as tabletop versions. Both enclosure ranges are available with an ergonomically favourable inclination angle for easy operation and improved reading of data.

ROLEC OKW Australia New Zealand P/L
www.rolec-enclosures.com.au

RADAR SENSORS

Turck has released a range of robust radar sensors for distance measurement up to 15 m, designed for use in rugged application areas in factory automation as well as outdoor or mobile applications. The rugged 122 GHz devices with protection to IP67/69K are shock resistant up to 100g and are suitable for distance measurement applications in areas such as port logistics, where traditional optical or ultrasonic sensors are unsuitable due to limited range or disturbance factors such as dust, wind or light.

The browser-based Turck Radar Monitor parameter user interface simplifies the set-up of the DR sensors by providing a real-time display of the signal curve. This is particularly handy when setting filters to suppress interference or in complicated mounting situations. When the devices are mounted in close proximity, the FMCW measuring principle prevents any mutual interference between the signals.

All DR-M30-IOL sensors are provided with IO-Link as well as an analog and switching output. The analog output can be configured as a second switching output. In conventional applications, the devices can operate without IO-Link. Three different lens configurations enable optimum device selection according to the application, depending on whether the required detection field is short and wide, medium, or long and narrow.

Turck Australia Pty Ltd
www.turck.com.au

AS I SEE IT

TURNING INSTALLED BASE INTO PROFITS WITH ONLINE MONITORING

After-sales service is often viewed as a competitive differentiator, a source of customer satisfaction, and often a profit generator. Successful organisations in the automation industry have a staff of engineers, technicians, mechanics or others charged with assisting customers in their maintenance and continued operation of the machinery long after the sale.

For customers, the elimination of unplanned downtime has become paramount to ongoing success. Many larger end users have invested heavily in preventive and predictive maintenance. Fortune Business Insights sees predictive maintenance experiencing a 29.6% compound growth rate through the end of 2026.

It makes good sense for you to be in the monitoring support business. There are four main reasons for a systems integrator (SI), OEM or machine builder to develop a fee-based monitoring business.

Customer intimacy

Rather than closing out the purchase of your equipment at the end of the warranty period, the relationship continues for the entire life of the machine. The support team's involvement changes from periodic and infrequent visits to ongoing. Most customers will see your periodic reminders for routine maintenance needs, suggestions for improvement and proactive calls as a display of caring customer service. Along the way, the uptime of your machine will improve and you will have the information to prove it. Customers value productive time and while you will not be 'competitor proof', selling against you will be more difficult.

Machine design improvement

Normally machine design issues are filtered by those providing feedback. Your sales team, customers and service people making visits are all sources of information and all subject to their own set of prejudices. Because monitoring machine issues live removes any filter, you can determine not only the design issue but the circumstances that may lead to the issue. Armed with this information, modifications can be suggested both as retrofits in the field and in future designs. The result is a more productive machine and a competitive edge for your customer.

Competitive positioning

Remote monitoring is equal parts predictive maintenance and IIoT implementation. The growth of predictive maintenance was cited above, but the statistics of IIoT use are even more impressive. According to a survey conducted by IIoT World, "Fewer than 2% of respondents are not considering an implementation (of IIoT) within the next 12 months." Integrators, OEMs and machine builders offering an IIoT-related offering will be perceived as technological leaders. Simply stated, if you have an offering and your competitor does not, you win.

Financial impact

Remote monitoring and related services drive a whole new revenue stream to the SI/OEM/machine builder market. Not only is this new cash flow, but it is also a predictable and smooth source of revenue. Not only will there be additional revenue from the services, but it further positions your organisation to capitalise on additional sales of machine updates, spare parts and other more traditional offerings.

Breakthroughs in technology have broken down the once costly barriers to getting into the business. More importantly, the technology is not costly, certainly not a capital expenditure at well under a thousand dollars. Most companies find they already have the right people on board to make this happen.

Remote monitoring gives you a 'low-hanging fruit' opportunity, with good returns achievable rapidly. Your organisation will become more competitive today, gain better access to customers and have a keener understanding of what your customers value.

Tom Hu is the Sales & Technical Services Manager at Global M2M. He has been offering one-stop secure remote monitoring product solutions to clients all over the manufacturing, irrigation, water treatment, waste management, and building management industries.

40 CELEBRATING YEARS

wfmedia connecting industry

Westwick-Farrow Media
A.B.N. 22 152 305 336

www.wfmedia.com.au

Head Office
Unit 7, 6-8 Byfield Street, North Ryde
Locked Bag 2226, North Ryde BC NSW 1670
AUSTRALIA
ph: +61 2 9168 2500

Editor
Glenn Johnson
pt@wfmedia.com.au

Publishing Director/MD
Geoff Hird

Art Director/Production Manager
Julie Wright

Art/Production
Colleen Sam, Linda Klobusiak

Circulation
Dianna Alberry
circulation@wfmedia.com.au

Copy Control
Mitchie Mullins
copy@wfmedia.com.au

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

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

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

If you have any queries regarding our privacy policy please email
privacy@wfmedia.com.au

Contact the editor

Printed and bound by Bluestar Print
Print Post Approved PP100007403
ISSN No. 0819-5447

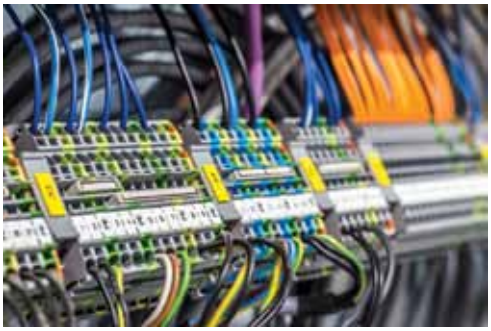
ASC Automation Systems and Controls Pty Ltd

Specialists in Automation Solutions

SKILLED TRADES, ON SITE SERVICE & SUPPORT


CONTROL PANEL MANUFACTURING





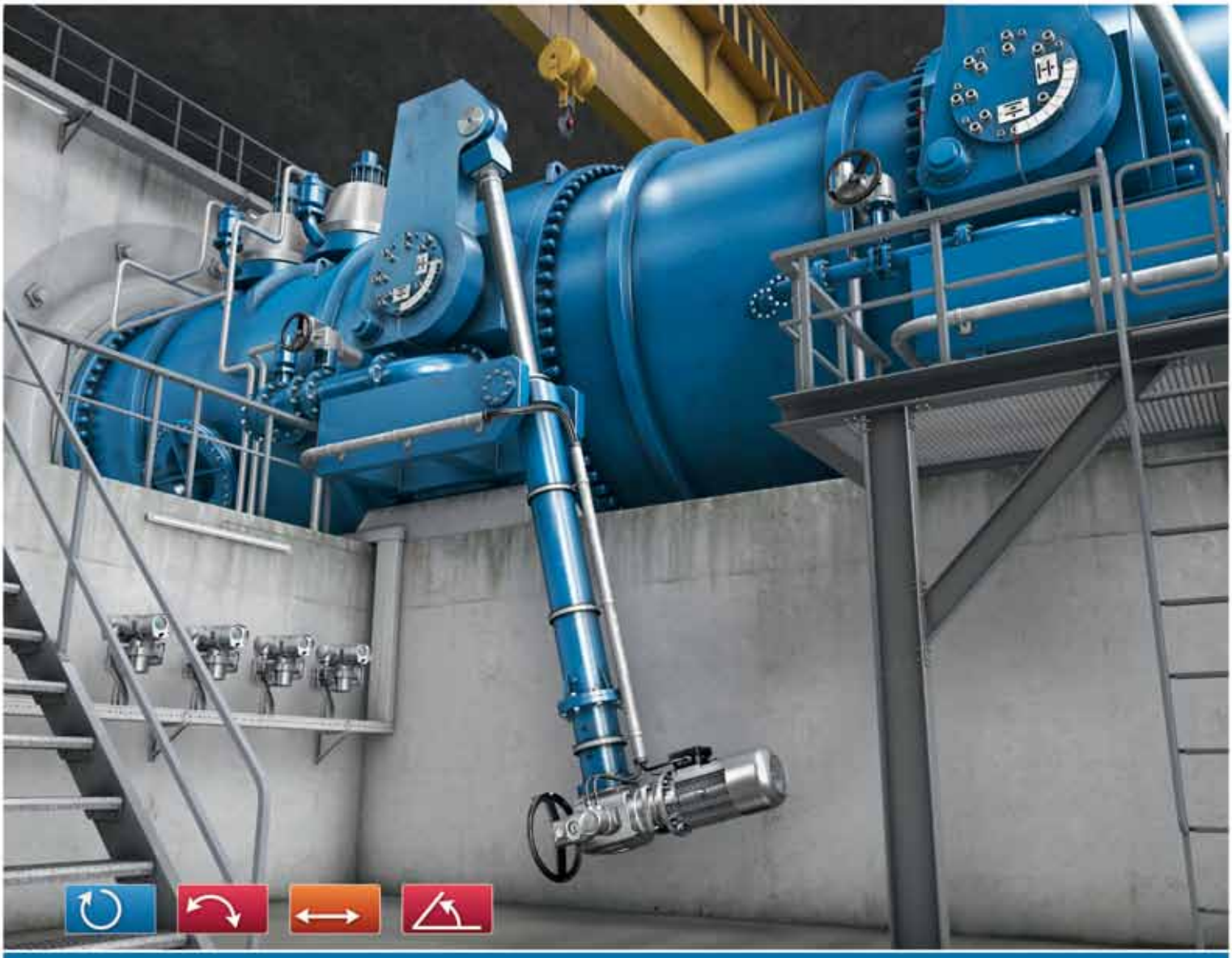
ADVANCED MACHINE VISION-AI DEEP LEARNING



BAR CODE READING SOLUTIONS SPECIALISTS



Call Now Ph: 0474 269 963



CONSISTENT AUTOMATION

Electric actuators for hydraulic steel structures

Reliable, powerful, robust.

For several decades, AUMA actuators have proved their reliability in automating sluice gates, butterfly valves and gates in weirs, fish ladders, locks, and hydropower plants.

AUMA's comprehensive portfolio covers torques ranging from 10 Nm to 675,000 Nm offering homogeneous automation schemes throughout the plant: from simple OPEN-CLOSE applications to level control using an integral PID controller.

Learn more about AUMA automation solutions
www.barron.com.au

BARRON

78 Dickson Avenue Artarmon
02 8437 4300
Info@barron.com.au