

# WNIPT

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ON THE COVER



Depending on job requirements, technicians with varying levels of expertise may need to use portable flow meters daily. To account for the differing experience levels and frequency of use requirements, the TransPort PT900 portable ultrasonic flow meter from Baker Hughes — a GE company — is so easy to install and intuitive to use that anyone can conveniently make a flow measurement in just minutes and then move on to their next task. They do not need to spend valuable time programming and installing the meter.

Since the clamp-on PT900 measures flow from outside a pipe, it does not require the process to be shut down for installation. Its portability allows it to be moved easily from location to location for temporary or spot flow measurements, or for check metering. The rugged transducers handle most pipe sizes and materials, and can measure liquids ranging from ultrapure to extremely dirty water, as well as hydrocarbon liquids and crude oil. This makes the PT900 suitable for industries ranging from oil and gas and petrochemicals, to water and wastewater.

Significant customer research and input informed the design of the PT900, leading to an all-new transmitter, clamping fixture and app-driven, and Android-compatible user interface. Available now from Thermo Fisher Scientific.

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# APPLICATIONS FOR CAMERAS

## IN RETAIL DISTRIBUTION CENTRES

When deployed strategically within a facility, image-based data capture technology offers benefits beyond its ability to read 1D and 2D codes.



**R**etail distribution centres (DCs) face continuously expanding throughput and accuracy requirements as they strive to meet their customers' expectations — whether shipments are destined for brick-and-mortar storefronts via truckload, or sent by a parcel carrier direct to the consumer. A DC's ability to quickly and successfully capture inventory information through its various processing areas, at increasingly high speeds, is often a critical component of a company's success.

DCs must implement automatic identification and data capture (AIDC) technologies to read and process the information applied to products. The chosen system, or combination of systems, must be able to read data at the individual (each), case and pallet level in one of two forms:

- **Linear/1D barcodes:** Data encoded in patterns of dark lines and light spaces, which can include UPC, EAN, Code 128, Code 39 and Interleaved 2 of 5 formats.
- **Matrix/2D codes:** Data encoded in round or square patterns of dark and light dots, including PDF 417, DataMatrix, Maxicode and QR code formats.

### Utilising a multimodal approach for AIDC

When it comes to reading 1D and 2D codes, two primary families of identification technology are available in the market: laser based (either line scan or omnidirectional) and camera/image based (area array and line array).

It is important to understand that both laser- and camera-based data capture technologies have their place in a retail DC. For some applications, laser and camera technologies can be used together. One does not have to replace the other in all situations. Applying a multimodal solution that selectively integrates camera-based technologies with new or existing laser-based technologies can yield a variety of process-based benefits while maintaining a sensible investment strategy.

When properly applied and installed, either of these technologies can achieve read rates in excess of 99.5% — or even 99.9% in some operations. Therefore, it is critical to work with a supplier who understands the key differences and can help identify which solution is the best fit for each ap-

plication within a facility and throughout a supply chain. Taking a balanced, multimodal approach, by stepping strategically into camera technologies by cost-effectively and selectively integrating them into an existing laser-based AIDC architecture, can maximise a return on investment as well as ensure the highest levels of operational performance.

### Overview of camera technologies

Also known as image-based code reading technology, cameras possess a scan engine that can read both 1D barcode and 2D matrix codes omnidirectionally (in any orientation).

Cameras come in two styles: area array cameras and line array cameras.

#### **Area array cameras**

Utilising a two-dimensional data capture imager, these cameras capture a full image of an entire region of an item, case or pallet at one time — similar to a snapshot taken with a digital camera. The image area is measured in pixels; for example, a 1024 x 768 pixel sensor captures a rectangle-shaped image at that resolution. The camera takes multiple pictures, capturing anywhere from five to more than 100 images per second, depending on the capabilities and actual resolution of the individual device. The images are decoded by the camera, which transmits the information to upper-level control systems.

Due to their image speed limitations and field of view (generally less than 40 cm wide), multiple cameras are typically required over a conveyor line for code reading. To ensure that a code is fully captured, two to six area array cameras must be set up side by side with a minimum 10 cm overlap of fields. In a situation where multiple area array cameras need to be used for adequate coverage, a single line array camera might be more cost-effective while offering improved capabilities.

#### **Line array cameras**

Utilising a one-dimensional array of pixels on a sensor, this camera technology takes the picture differently than the area array camera. Instead of taking the full image in one snapshot, this device acquires slices of the image progressively as the item moves through the illumination field. This technology produces extremely high-resolution images,





CERTAIN RETAILERS AND CARRIERS REQUIRE SUPPLIERS TO PLACE A CODE-BEARING LABEL IN A CONSISTENT LOCATION ON A CASE OR PARCEL TO ACCOMMODATE THEIR SUPPLY CHAIN'S HANDLING PRACTICES. NON-COMPLIANCE CAN TRIGGER A FINANCIAL PENALTY, OR CHARGEBACK, THAT CAN NEGATIVELY IMPACT A SUPPLIER OR DC'S REVENUE.

even at very high transport speeds; the newest devices on the market are capable of 30,000 scans per second at an image width of up to or greater than 8000 pixels. The resulting high-resolution images produced make this system ideal for reading the widest possible range of codes. The lines are assembled in a two-dimensional image of the code, enabling optical character recognition (OCR) or other external image processing. Integrated code grading tools also tend to be more accurate and consistent in line array camera systems than those in area array cameras due to the improved illumination consistency throughout the field of view, and the continuously adjusted focal distance.

Because of how they function, line array cameras have an inherently large field of view (the limits of the image area that can be captured by the camera) and depth of field (the distance between the nearest and farthest objects that can be captured in acceptably sharp focus). This technology is typically more costly than an area camera; however, a single line array camera can cover a 100 cm-wide conveyor with 90 cm tall cartons, which could take two, three

or even four area cameras in some cases, making it the more cost-effective solution with premium performance.

### Ideal applications for cameras in retail DCs

Because of their ability to read any type of 1D or 2D code and to generate an image as large as the side of a pallet load (depending on the installation), the ideal applications for camera-based solutions in retail DCs are at a point of divert or induction within an automated conveyor system. Again, cameras can be added exclusively or integrated with laser scanners for a multimodal installation.

Fixed-position cameras are frequently mounted line-side in up to six axes to cover all six sides of a target item (each, case or pallet): overhead, all four sides and underneath between gaps in belting or rollers. The information captured by the camera(s) is routed to the warehouse management system (WMS), which determines the scanned item's destination.

For example, a five- or six-sided scan tunnel can be set up at the point of inbound

receipt of pallets or cases. Applied to fully automated handling, the system accommodates a range of package and label sizes marked with inconsistent code types, quality and placement. This application could use cameras (solely, or in combination with laser scanners — such as with one camera placed overhead and underneath, where the majority of labels are located) to quickly identify and route product to its next destination, such as storage, forward picking, cross-docking and more. The cameras capture images to document and record any read errors that may occur.

Likewise, at retail DCs handling inbound receipt of eaches — with cases broken open for storage of individual items to fulfil catalogue and e-commerce orders — fixed-position area array cameras that permit hand presentation at any angle can be implemented. These hands-free devices allow operators to work ergonomically while reducing the required hardware investment associated with handheld RF terminals.

Further down the conveyor line within a facility, cameras might be located at various routing points to identify an item. The data captured is used to verify its destination, then activate a divert or induction to a different area of the facility (storage, forward picking, cross-docking etc).

For facilities producing labels for outbound shipments to other partners in the supply chain, or direct to consumers, a scan tunnel equipped with cameras can verify the print quality and proper placement of a code sourced by an automated label print and apply machine.

### Benefits of camera-based AIDC to retail DCs

In addition to their ability to read any type of 1D or 2D code, the digital picture that cameras capture can be useful in many other ways.

#### Reading damaged or poor quality codes

Thanks to sophisticated algorithms, camera-based scan engines can make mathematical interpolations to interpret the missing data — essentially filling in the blanks. Some examples

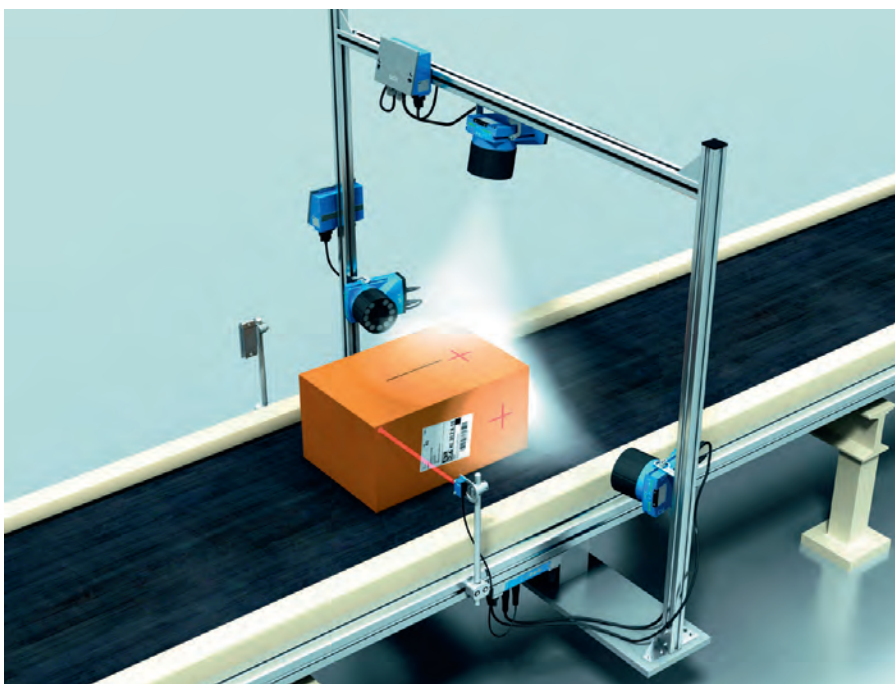


Figure 1: With area array cameras, multiple cameras are typically required.



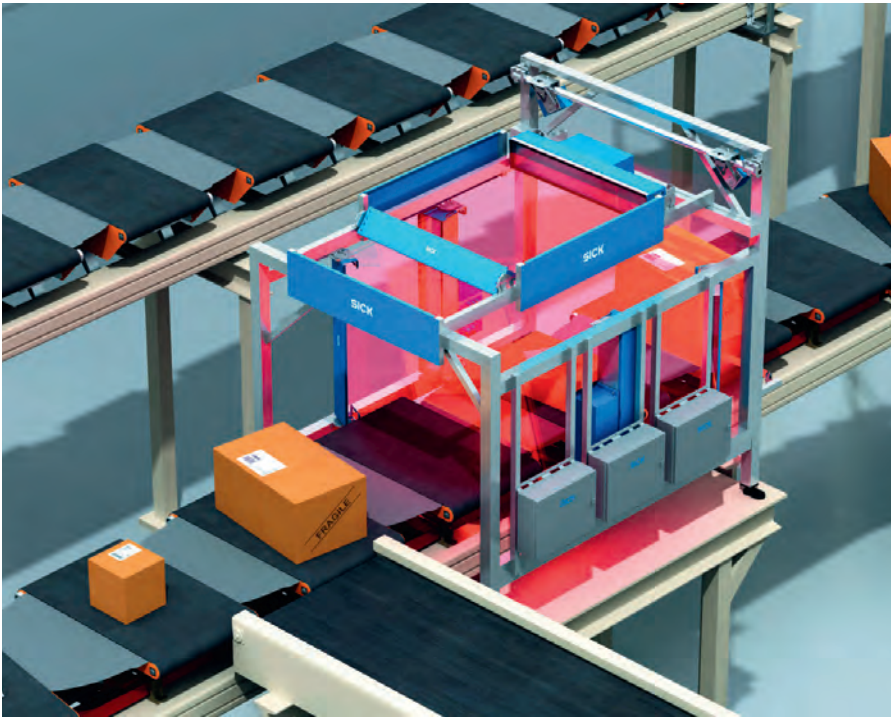


Figure 2: Line array cameras acquire images slice by slice at high speed.

of printed code symbol problems that may see improved readability characteristics include code contrasts below 30%, insufficient quiet zone and vertical voids caused by a missing print element. Users may choose to invest in camera/image-based code reading technology in an effort to maximise read rates.

Additionally, the captured digital image can be sent electronically to the source of the shipment for documentation of the code read error and subsequent root cause analysis, such as operational influences such as a misaligned or rotated carton, damaged label or poorly printed code.

#### **Vendor compliance for code placement**

Certain retailers and carriers require suppliers to place a code-bearing label in a consistent location on a case or parcel to accommodate their supply chain's handling practices. Non-compliance can trigger a financial penalty, or chargeback, that can negatively impact a supplier or DC's revenue.

As with the previous example, the camera technology's ability to capture an image of the entire side of the case or pallet documents the error at the inbound point of receiving. Archiving the image at the outbound point enables the label's producer to document the proper placement of the code. The images can be used later for analysis and process corrections.

#### **Code qualification**

Quality standards for 1D and 2D codes have been established by the International

Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). Quality is assessed based on different characteristics, including symbol contrast, modulation and time to decode, utilising quality control verifiers. The verifier assigns a grade, or rating, typically on a numeric scale. Because speed of decoding is important throughout a supply chain, most trading partners establish a minimum acceptable code grade for their operations. Non-compliant codes that do not meet the minimum grade are subject to chargebacks.

To be clear: A camera-based imaging system is not a verifier. However, the images captured by camera-based scanners can be used to perform 'qualification', or inline monitoring, of the quality of a code. A camera-based system reads and analyses every symbol that passes by it, measuring it against preset parameters regarding print quality. When coupled with data collection and analysis software, trends regarding even minor changes in a code's characteristics can be identified. By tracking these changes over time, operational issues — such as dirty or burned out print heads, clogged ink jet nozzles, dirt, wrinkles or other defects — that reduce the symbol's grade can not only be identified, but also predicted. This allows a facility to both implement corrective actions and improve overall preventive maintenance activities to prevent a slow-down in production.

#### **Quality control**

Camera-based imaging systems can be set up to verify and document the contents of a carton for confirmation that the right items were picked in the correct quantities prior to case sealing and shipment. The condition of the box on departure or receipt can also be digitally documented and archived. Should the receiver report damage to the package and its contents, or that items are missing from an order, the photographic evidence can be retrieved for confirmation and picking validation.

#### **Process evaluation**

Because they can be set up to capture an expanded field of view, cameras can also be used to examine the package and the surrounding automation technologies handling it. For example, if cartons are consistently being damaged somewhere along the conveyor line, the images captured by cameras can be useful in determining the cause and its location — such as incorrect or inconsistent spacing between items, wrong placement on the conveyor or undersized/oversized loads.

#### **Summary**

As camera technology continues to evolve and become more cost-effective, the discussion as to what other things the user might want to do with the image will drive the identification technologies used within retail distribution networks. But for now, camera-based technologies remain one possible AIDC solution among a broad arsenal of technologies, with advantages that lie beyond their ability to read both 1D and 2D codes. Among the benefits are quality and process control analysis; documentation to manage vendor compliance; troubleshooting for the root cause of problems with codes and labels; and verification of their placement on the cases, cartons and pallets they identify.

Through proper application of the right technology in the appropriate areas of a facility, retail DCs can benefit from efficient, cost-effective solutions to their data collection.

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## OIL-IN-WATER SENSOR

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## PORTABLE OSCILLOSCOPE

The 200 MHz Fluke 190 Series II ScopeMeter is designed for engineers in the field who require a lightweight oscilloscope for use in harsh industrial environments.

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## THIN CLIENT REMOTE MONITOR

The VisuNet GXP remote monitor brings a compact, modular design to hazardous areas that allows for easy set-up and maintenance.

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## Namibia brewery reduces energy costs and improves sustainability



With regard to renewable energy, Namibia Breweries Limited (NBL) has put into practice what others only talk about. The company has a 1 MW roof-mounted solar plant with more than 4000 panels, 66 inverters and four cluster controllers. The whole system is connected to three of the company's generator sections. When it was installed in 2013, it was the largest hybrid system in the world and it also made NBL completely self-sufficient regarding electrical power.

But this was only the start. Electricity, though a major component, is only one factor in the complex world of utilities which, today, are highly significant contributors to product costs, competitiveness and profitability. And there's more to effective utilities management than simply watching the meter.

A manufacturing operations management survey conducted by LNS Research showed that the top two operational challenges for meeting strategic manufacturing objectives were that companies had to deal with disparate systems and the lack of cooperation across their different departments.

"In our case, we have the brewing, packaging and distribution departments," said André Engelbrecht, manager: industrial control systems, NBL "Each of them focuses on doing their job to the best of their ability, but without necessarily much concern for the common denominator that makes it all possible: utilities."

NBL decided to unify its various departments into a cohesive entity that could make real-time business decisions with regard to utility usage based on a single version of the facts. The scope of the implementation would include access to the CO<sub>2</sub> plant, NH<sub>3</sub> ammonia cooling, boiler house, water treatment plant, sterile air plant and power meters.

The goal was to be able to record critical production information from the solar, NH<sub>3</sub> cooling, boiler and CO<sub>2</sub> plants, as well as from the water

and power meters. NBL also wanted to be able to transfer production information to the existing DCS, and to develop a dashboard system for management to view consumption-related information linked to production volumes and KPIs.

The project was started in February 2015 and changeover to the new system was achieved after a two-week parallel operation during January and February 2016. But according to Engelbrecht, this is not the end as it is a "living" system designed to grow and supply the company's information needs well into the future.

NBL has a central DCS which controls the beer-making process from beginning to end, but in order to achieve NBL's goals of accurate decision support based on reality and real-time production information, more data collection and collation resources would be needed.

NBL implemented a Schneider Electric information management solution to consolidate data collection and optimise operational visibility across brewing operations.

It implemented Schneider Electric Software's historian to consolidate data acquisition, storage and reporting. The solution now allows users to view utility consumption and production data from anywhere in the plant, increasing operational visibility for improved decision support.

"Having real-time information available at the click of a button is the key to a modern manufacturing business enterprise," said Bernd Esslinger, engineering manager at NBL.

With data now available from across brewing, packaging and distribution, users can work from a single source of truth. Daily, weekly and monthly reports show water, electricity, chemicals, thermal energy, solar generation, carbon dioxide and air consumption, comparing results with KPI targets. Critical production data is displayed on dashboards in real time and linked to KPIs. In the future, Namibia can use this information to turn off non-critical plant equipment to increase sustainability and help avoid unnecessary costs.

"We were drawn to a Schneider Electric software solution because of its scalability and ease of use, as well as their deep industry expertise and focus on customer needs," said Engelbrecht.

"Energy consumption is one of the highest costs faced by food and beverage manufacturers today. Consolidated, contextualised real-time data is critical to effectively minimise utility management costs," said Rob McGreevy, vice president of information, operations and asset management at Schneider Electric. "We have helped Namibia improve operational performance by enabling better visibility and decision support across their value chain."

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### LASER FORK SENSOR

Production sequences in the pharmaceuticals and food industries are subject to demanding hygiene standards. With corrosion-free stainless steel, FDA conformity and Ecolab certification, Wenglor's P1HJ00X laser fork sensor in InoxSens hygienic design provides maximised protection when detecting objects.

Objects with sizes down to 40  $\mu\text{m}$  can be detected by the fork sensor. Utilising a collimated laser beam, objects can be detected within the entire fork width, with fork widths of up to 220 mm.

The gap-free design with a glass or plastic optic cover enables the fork sensor to be resistant to cleaning agents in hygienically sensitive industrial environments. Together with the hermetically sealed housing, captive components provide for high levels of protection up to IP69K. Beyond this, the light barrier can be easily and conveniently adjusted directly at the sensor by means of a teach-in button.

The sensor can be used wherever numerous objects travelling at high speeds have to be detected, making it suitable for packaging and the paper and consumer goods sectors, in addition to the pharmaceuticals and food industries.

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### PORTABLE ULTRASONIC FLOWMETER

The Polysonics Hydra SX30 is a portable flowmeter which combines dual frequency doppler (DFD) technology with digital signal processing to deliver high performance and simple operation. It is available to rent from TechRentals.

The product generates two independent ultrasonic signals to help eliminate external noise. This makes it suitable for the measurement of aerated or solids-bearing fluids in applications such as slurries, dredging, and primary or activated sludge.

The ultrasonic non-contact doppler flowmeter comes with NEMA 6 environmental sealing and can be operated continuously for up to 12 h. It has a transducer temperature range from -40 to 122°C and an analog output of 4–20 mA.

Measurable velocity range is from 0.06 m/s to 10 m/s with an accuracy of  $\pm 1\%$ , with pipe sizes ranging from 12 mm to 5 m in diameter. Data logging is available for up to for 90,000 points, and PC software is available to download via an RS232C interface.

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### LIGHT SECTION SENSORS

Pepperl+Fuchs' SmartRunner technology is a combination of light section technology and a 2D vision sensor with integrated LEDs. It belongs to a family of high-precision sensors, tailored and preconfigured to handle specific applications. The optics, camera and evaluation logic are integrated into a compact housing and transform complex data into easy-to-process digital signals. Laser light technology is ideally suited to detecting, monitoring and protecting even the smallest of objects. It provides reliable measuring on any material regardless of surface contour or colour.

Easy set-up is a key feature when commissioning SmartRunner sensors. With teach-in, specific application requirements can be customised in a few seconds — without a PC or special expertise. Due to an integrated vision camera, sensors can be easily parameterised using Data Matrix control codes. It is a simple application-specific plug-and-play sensor with no complex parameterisation for application adaptation. Once a code has been generated, users can teach-in any number of sensors. The SmartRunner technology ensures ease of use for applications in the automotive industry, for machine tools, and for packaging and material handling, especially when production is frequently adjusted.



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## CLIMATIC TEST CHAMBER

Angelantoni test chambers simulate and replicate the conditions under which machinery, materials and components might be exposed. They are commonly seen in industrial R&D labs and used to accelerate the effects of exposure to the environment or pre-programmed special conditions. Industries mostly seen using the high-tech equipment are automotive testing, aerospace, artificial intelligence, electronics, renewable energy, and industrial and consumer research.

The Flower testing lab, when compared with an equivalent conventional environmental chamber, can save up to 25% in energy when operating over a continuous 24 h testing cycle. The technology used in the Flower testing lab allows the compressor to keep to the lowest rotation speed (by means of the inverter) and excess cooling capacity is used to cool a 'cold sink'. The system's software, MyKratos, with its included power management algorithms, maximises performance and minimises energy consumption.

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**NEW  
PRODUCTS**

## FIBRE LASER MARKERS

Omron's MX-Z fibre laser markers are designed for deep or shallow engraving on metals and fine mark processing on plastics. With durable IP65 certification, the laser head has a double glass cover for stable operation even in dusty and wet environments. The product further meets international standards and regulations with two built-in safety relay circuits to meet with ISO 13849-1 criteria.

The device features two operation modes — standard mode and Energy Enhanced Mode (EE) — that allow users to choose from fine detail or deep engraving depending on their application. The standard mode offers flexible pulse control of up to 1 MHz (1–20 pulses adjustable) for optimum high-speed marking. The EE mode is for deep engraving of metal and intense energy processing with increased pulse control of up to 30 pulses.

Using a flexible high-precision z-axis, marking on 3D objects is possible, including sloped, curved, conical or sphere-like surfaces. Marks can be clearly marked on any object at a high speed due to Omron's Galvano Dynamic Acceleration Control (G-DAC) feature that adjusts the speed according to the marking details for clean marking. All the marking data can be edited on the laser marker without the need for an additional software, simplifying the process.

The series can work stand-alone with its direct finder link feature, which directly connects the image processing system to the laser marker. Alternatively, the product can connect to various external devices (such as PLCs) via EtherNet/IP, serial communications or digital I/O.

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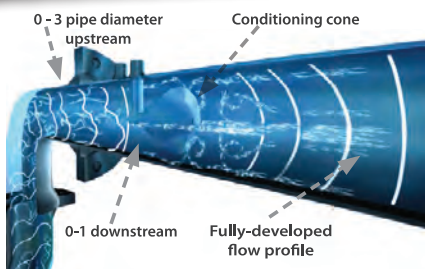
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## Integrated approach to coal mine recommissioning delivers maximum benefit

A three-pronged approach to mine rehabilitation and recommissioning has paid handsome time, cost-efficiency and community dividends for Glencore as it brings its Integra coal mine in the Hunter Valley back into production.

Integra commissioned the Chute Technology engineering partnership to handle in an integrated way a succession of tasks vital to the mine's reintroduction that would normally be handled in separate stages, taking longer to coordinate and costing more. The result has been completion on time and on budget for the complex series of tasks, within the narrow nine-week window of time required by Integra. The mine was on schedule to deliver first coal from the longwall by mid-year and continues to build workforce numbers. Glencore made the decision to reopen the Integra underground mine in 2016 after purchasing it from former owner Vale in 2015. The mine had been in care and maintenance since 2014.

"Integra was very smart in the way it approached this recommissioning," said Chute Technology Partner Tom Woods. "Thanks to the integration of tasks and our productive partnership with Integra's on-site team, we not only got our components of the process chain up and running in the required time frame, but we also boosted capacity and resolved output issues with old plant not suited to higher volumes. The reopening of Integra has been very well received across the Hunter industry.

"The recommissioning process was handled in a very different way from a typical mine rehab piecemeal approach of solving problems in one area of plant, only to see further delay as production bottlenecks are then discovered further up the line. It's like shooting ducks in a row — the ducks just keep on popping up. You have to take an integrated approach that goes to the root of systemic issues," said Woods.

Essential to such an integrated approach are elements such as diagnostics, structural audits, DEM modelling, finite element analysis (FEA), process design, detailing, one-stop manufacturing processes and the ability to provide complete turnkey projects. Chute Technology worked directly in partnership with the mine managers and engineers, so that they were able to have ownership in the design and get the results they wanted.

Chute Technology's task began with a full structural audit of the surface conveyor system, which was carried out on the same day it was requested.

"Our visual site inspection of the conveyor system told us immediately that this was going to be a very challenging project to complete in a short period of time, because the mine needed to be and running by February 2017," said Woods. "So we put together a fully costed schedule of the quickest time frame to have development coal



*Glencore Integra Engineering Manager David Young and Operations Manager Peter Ostermann in front of some of the plant involved in the project.*

running on the belt to drop on the surface. The project scope included design, manufacture of new equipment, repair and optimum re-use of old equipment, and introduction of a temporary overland radial stack-out conveyor system for the development coal only.

"The job was a diverse one — which included new hoods, spoons, chutes, structures and transfer towers — but we managed to get development coal on the surface on 23 February 2017."

The task involved a design and build time of nine weeks from the time the project scope was finalised, overcoming major challenges including: a short time frame for the number of tasks involved; the redesigning of new conveyors; the sourcing of specific appropriate equipment over the Christmas–New Year period; and thoroughly understanding the mine's specific procedures and how best to meet partners' expectations and expedite throughput.

"For cost efficiency and speed, we incorporated a maximum of modified and re-used existing infrastructure from the Integra site and other Glencore mine sites. This conservation of valuable resources was undertaken specifically to achieve the best, safest, most cost-effective and time-efficient frame for this project."

Benefits have been immediate. "The revitalised conveyor system is working to its designed capacity and working well," said Woods. "As a result of the success, we have also been engaged by the mine to further streamline and enhance production by redesigning, manufacturing and trial assembling, in our workshop, a complete new tail end, transfer point, hood and spoon for the bottom of the drift conveyor, so as to accommodate longwall coal."

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# CONTROL SYSTEM MIGRATION

SURVIVING THE 'PERFECT STORM' TO  
IMPROVE PERFORMANCE — PART 1

Industrial companies are faced with an increasingly competitive business environment. Manufacturers must find ways to produce quality products quickly, efficiently and cost-effectively. Experience has shown control system performance can have a huge impact on return on investment (ROI) throughout the life cycle of the plant.

**W**hen it comes to keeping automation technology up to date, proactive is the new normal. Companies that migrate to a newer, more effective control system gain a significant advantage over competitors that simply wait for assets to reach end of life. The 'doing nothing' option simply isn't viable. Automation systems are no longer isolated and, with the high levels of integration of the diverse systems, there is a high likelihood of a technology mismatch within the automation infrastructure. A well-planned and executed migration strategy is now a must. A structured and organised approach to upgrades enhances the benefits of new technology, reduces risks and preserves valuable intellectual property.

## Skills shortage versus new technology

In an uncertain global economy, every manufacturer is under growing pressure to reduce their costs while improving performance. An ageing and rapidly retiring skills base and the ever-increasing

pace of technology development only compound this situation.

Studies indicate experienced and knowledgeable employees are leaving the industrial sector in large numbers. A report issued by Deloitte and Oracle<sup>1</sup> showed that among companies involved in skilled production, 51% reported labour shortages and predicted future resource issues as younger generations forego careers in manufacturing. Some observers believe the demand for expert personnel will exceed availability within the next 5-7 years.

Approaching retirements within the baby boomer workforce threaten the very operation of facilities that currently run on legacy control systems. Moreover, efforts to prepare new millennial-age employees to take over critical operational positions have had mixed success. There is a lack of interest from this new generation to learn and live with 30-year-old technology.

The emergence of new technology also places demands on companies involved in complicated businesses such as oil and gas refining, pulp and paper production, and mining and minerals



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extraction. Given the size, scope and complexity of modern engineered systems and their interactions, it is becoming increasingly difficult for people to anticipate, diagnose and control serious abnormal events in a timely manner.

### Business challenges on the horizon

There is little doubt that today's experienced worker shortage and greater demand for energy savings, environmental protection and improved operational effectiveness create significant business challenges and require industrial organisations to look closely at different solutions for technology refresh and upgrades.

The problem of 'technology churn' has only exacerbated the hurdles faced by industrial facilities, placing heavy demands on managers who must adapt their skill sets to become like software companies and big data firms.

The convergence of people, parts and planning issues has created a perfect storm threatening potential disruptions in the

industrial sector. Plant managers cannot afford a 'wait and see' attitude when it comes to ageing automation assets. The life cycle of electronic components is rapidly shrinking, and frequent updates of software and hardware are now required. It can also be difficult to find personnel qualified to troubleshoot and repair an older control system. As operators and engineers familiar with the existing platforms reach retirement age, outside support often becomes necessary.

In the automation world, legacy distributed control systems (DCSs) and their components are inching closer to their end-of-life point. These systems may no longer meet corporate objectives for enterprise-wide sharing of business information; nor can they enlist advanced control capabilities enabling increased throughput, lower costs and improved regulatory compliance.

In its 2015 report 'Distributed Control Systems Worldwide Outlook'<sup>2</sup>, the ARC Advisory Group stated: "Whether called 'migration', 'evolution', or 'modernization', transitioning to a more modern DCS presents end users with significant challenges. These range from the difficult task of justifying the automation investment in the first place, selecting a supplier, and implementing the solution, to providing a roadmap for the future. Most end users list migration as one of the key issues they face today. ARC has estimated that \$65 billion worth of installed process automation systems in the world today are nearing the end of the useful lifecycle, which, in many cases, can exceed 25 years. Many of these systems — as much as \$12 billion worth — are some of the original DCSs installed in the late 1970s."

Poor process control with an outdated DCS may result in inadequate quality and excessive energy usage. When processes are controlled near set points, quality is maximised. Deviations from set points, particularly for extended periods of time, can directly impact quality in a negative way. Throughput can also be affected by performance.

Ironically, many manufacturers treat their business systems and email servers very differently to their process control systems. Companies make a concerted effort to keep IT infrastructure current, both in terms of hardware and software, and routinely engage in annual maintenance contracts and investments in cybersecurity technology. The same level of emphasis is not yet common in plant automation departments.

Failure to address looming automation obsolescence issues could lead to crucial assets being rendered inoperable if an ageing component should fail and no replacement is available. This is true of both factory- and third-party-sourced parts. Worse yet, spares obtained from auction sites over the internet may unknowingly introduce unexpected effects on critical systems. Financial loss or possible unsafe operating conditions from an unplanned outage could far exceed the replacement cost of a discontinued part. The economic risk or liabilities from neglecting these potential problems are way too high to ignore.

### Anticipating the need for modernisation

A control system is the central component that determines the productivity and flexibility of a process industry plant. Old systems may still work well after 10, 20, 30 or even more years — but migration to a current automation solution not only minimises risk of failure, it also opens up a whole range of completely new possibilities.

With updated technology, for example, the remaining economic life of legacy control and safety equipment can often be extended by 30–50%. Replications of controller software and common displays may reduce the engineering effort for the control system expansion





THE PROBLEM OF 'TECHNOLOGY CHURN' HAS ONLY EXACERBATED THE HURDLES FACED BY INDUSTRIAL FACILITIES, PLACING HEAVY DEMANDS ON MANAGERS WHO MUST ADAPT THEIR SKILL SETS TO BECOME LIKE SOFTWARE COMPANIES AND BIG DATA FIRMS.



by up to 50%. Likewise, improved reliability with modernisation, better diagnostic features and the use of common network technology can enable significant maintenance cost reductions.

In most cases, there is a specific rationale for migrating or replacing an obsolete control system, as well as improving the security of the control network infrastructure. In general they include:

- End of service life — replacing equipment experiencing end-of-life issues due to corrosion or age
- Futureproofing system components — the need to lock in vendor support for base hardware and software
- New units or upgrades — adding or modernising a unit to ensure it is a viable long-term solution
- Loading issues — current systems nearing their performance capacities
- Amalgamation of operating consoles — improving operator performance in the central control room
- Cross-unit closed-loop control — the ability to tie together multiple control networks and systems for cross-controller control
- Cost reduction — reducing footprints and enhancing controller performance
- New value-added features — including improved alarm management, operator effectiveness and asset management solutions
- Co-existence with multiple vendors and applications — this may not be possible or easily done with older system components
- System security — isolating the human-machine interface (HMI) and controller level from viruses found in upper-level networks
- Process data at the desktop — providing a secure path for required data that allows improved decision-making at the business level, creating real operational agility.

It is important for control system end users to avoid a scenario whereby they remain in place by investing in certified recycled spare parts, then 'drop off the face of the Earth' at some point in the future due to end-of-life issues. The 'do nothing' approach carries sizeable risks. Rather, they should work with their automation supplier to cost-effectively migrate forward to mitigate issues involving the ageing workforce, support of multiple system types, maintenance costs for older systems, etc. At the end of the technology evolution cycle, the user will have paid for an automation solution that is both modern and state-of-the-art while maintaining predictable control of their capital budget.

Effective modernisation initiatives enable manufacturers and other industrial enterprises to realise the benefits of new technology in terms of improved plant safety, profitability and reliability.

In addition, migration solutions can provide flexibility to plants to transition legacy equipment at their own pace.

A well-executed strategy to address technology obsolescence delivers significant operational and business benefits through seamless integration of new and existing plant automation assets. At the heart of this approach is multigeneration co-existence of control equipment. It enables tight integration with multiple generations of systems while retaining intellectual property in native graphics and advanced control applications. By incorporating existing data, events and operator messages into the control architecture, and establishing a common operator interface, the legacy system appears as an extension of the new automation solution.

In addition, a proprietary hot cutover technique enables the control system to be migrated while operations remain undisturbed. Legacy controllers can be replaced with newer versions on a live process while retaining wiring and cabinets.

### Upgrade before operational issues arise

Industrial organisations must immediately do proper planning and budget allocation for control system upgrades in order to avoid resource scarcity. Leading global automation suppliers have data indicating hundreds of thousands of legacy DCS nodes and thousands of software licences will soon become obsolete or phased out.

It is clear that inaction on migration strategies is causing existing services to be underutilised and, by early in the next decade, a crossover will occur where demand for control system upgrades will outstrip the available qualified resources.

### In Part 2

In Part 2 of this article, the process of incremental migration to reduce capital expenses is explained, as well as how outcome-based service programs optimise day-to-day support of control platforms and reduce total cost of ownership.

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## HOW SMART INDUSTRY IS CHANGING OUR WAY OF DEVELOPING

The industrial world is rapidly changing with the emergence of 'Smart Industry'. Today's production machines have become highly integrated mechatronic systems with a significant amount of embedded software. This fact requires engineers from all three mechatronic domains — mechanical engineering, electrical engineering and software engineering — to work together concurrently and evolve their ways of designing, testing and verifying machine software in order to reach the expected level of functionality and quality.

As industry evolves, software components provide a significant part of the entire added value in machines or production plants. Embedded software running on PLCs, industrial PCs or FPGAs (field-programmable gate arrays) involves closed-loop control functionality that ensures product quality as well as providing predictive maintenance algorithms for increased uptime without service intervention.

The growing trend towards increasing the size and complexity of the code installed on production machinery is a challenge for classically trained machine builders. Many are mechanically focused and need to maintain experience with elaborate workflows and toolchains for mechanical construction. When it comes to software design, machine builders are often unaware of tools for modelling, simulation, automatic testing and code generation, which are widely used by their engineering peers in aerospace and automotive industries.

While it may be obvious for serious mechanical engineers to use a CAD tool and run simulations before physically building the mechanical structure of a machine, in the case of embedded software it is entirely different. A major portion of machine software is still programmed manually and only comprehensively tested when the machine becomes available.

Another major factor in the evolution of industry is the growing amount of data. Vision sensors, drives, production machines and power plants all collect a growing amount of measured data during operation. However it is only the analysis of that data



that makes it possible to gain knowledge about product quality, energy consumption, machine health status and other economically relevant parameters.

This is where the use of analytical and statistical algorithms for condition monitoring and predictive maintenance is beneficial; they can be used to derive actionable insights from data that has been collected and stored in files, in databases or in the cloud. This concept is taken one step further with model-based predictive maintenance, in which an observer model is utilised that is capable of deriving states for factors that cannot be measured directly.

The large amount of measured data is collected by sensors and pre-processed by controllers or other processing hardware on the plant floor. The results are forwarded to some form of gateway or data collection point. The sensors, controllers, gateways and high-level analytic software act together to form a dense network known today as the Industrial Internet of Things (IIoT).

To become innovative leaders in their market, equipment manufacturers need to rapidly develop skills and expertise in these new design approaches and technologies. As mechanical engineers typically are not experts in software engineering, they can increase their productivity and system reliability by using model-based design tools that can generate code automatically for specific hardware platforms.

Models enable intuitive and clear construction from predefined building blocks with continuous verification. With this approach,

design flaws are corrected early on, which considerably shortens design cycles. Next the algorithms need to be implemented, which can be considerably challenging using traditional methods. Historically, algorithms typically had to be developed by experts in the relevant programming language. This practice is not only time-consuming, it is also prone to errors with the ever-increasing complexity of the algorithms used in machinery. Manually implemented functions — even though they have already been verified through simulations — may contain errors and not behave the way they were intended to.

In contrast, when real-time functionality is directly generated using automatic code generation, these errors can be avoided. Doing so not only saves time but also enables the creation of innovative solutions with smaller development teams. Model-based design with automatic code generation enables engineers to fully leverage their expertise in construction to build a machine or plant without worrying about programming language details.

Smart Industry encompasses the growing complexity of software and an ever-increasing amount of data. In the long term, these trends will challenge engineers to become proficient in using new methods and tools in order to embrace this complexity. For now, industrial companies who manage to shift their focus towards interdisciplinary design thinking (rather than production thinking) will emerge from the transformation as leaders in their areas and with new business models for their market.



*As Industry Manager for the industrial automation and machinery field at MathWorks, Philipp Wallner is responsible for driving the business development of this industry*

*segment that comprises energy production, automation components and production machines. Prior to joining MathWorks, Philipp worked in the machine building industry, where he held various engineering and management positions.*



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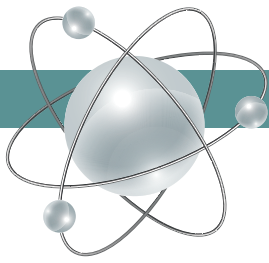
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## Adjustable multibeam antenna improves reliability of RFID systems

The Fraunhofer Institute for Integrated Circuits IIS has developed a multibeam antenna that can be integrated into existing systems and improve their reliability.

RFID technology does not require any contact to detect objects with electronic information tags, speeding up a variety of processes in production, logistics and retail. In cases that require high levels of object identification accuracy, a high-performance antenna is needed that is capable of capturing the information stored on the RFID transponders at any time.

Fraunhofer IIS has developed a multibeam antenna for challenging scanning scenarios. Due to its nine directional beams, the antenna provides high levels of accuracy when capturing data from transponders within its more flexible read range. At the same time, it optimises the reliability of RFID systems.

"The antenna provides up to nine individual beams, allowing for directional reading of transponders," explained Dr Mario Schühler, group

manager antennas at Fraunhofer IIS. "This way, we achieve a higher read range and accuracy without mechanical adjustment of the antenna. As a result, we can be more specific about what RFID transponders we detect and read."

Due to its flexibility, the multibeam antenna can replace several individual antennas installed in different locations. This lowers procurement costs and reduces the time and money spent on installation and maintenance.

Replacing standard antennas with the multibeam antenna improves the accuracy of readings from RFID identification systems. Because the multibeam antenna can detect directional movement, it can distinguish, for example, between incoming and outgoing goods or between moving and stationary objects. This capability helps users of RFID systems to select which transponders to actually read.

In addition, the antenna is optimised for bulk reading, meaning it can scan multiple transponders concurrently. The multibeam antenna also achieves high rates of data capture with metal objects and liquid containers.

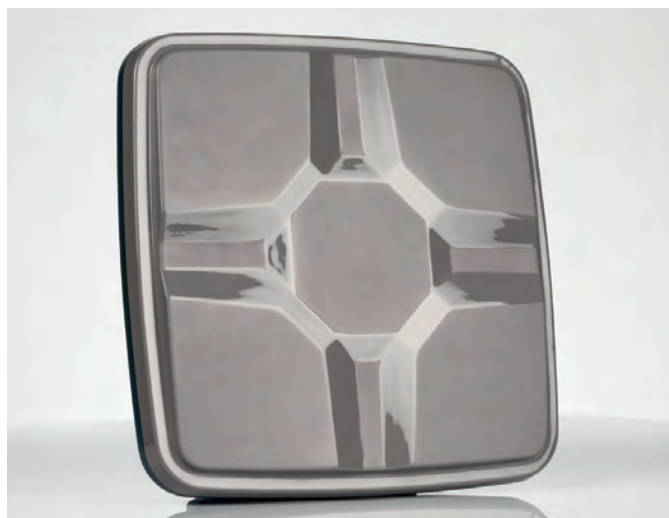
The antenna can be used in conjunction with standard readers and can be easily integrated into existing RFID systems. It is suitable for all ultrahigh-frequency applications and for both indoor and outdoor use. With its broadband frequency range of 860–960 MHz, the antenna meets international RFID standards and can be used worldwide. Switching to the multibeam antenna provides global companies with the opportunity to standardise their identification systems along the entire value chain.

The multibeam antenna can be operated anywhere electronic identification systems support processes for detecting, allocating and tracking materials, components and goods. RFID technology accelerates processes and increases the transparency of operations, especially in the retail, health care, automotive, electronics, logistics and transport, production and automation sectors.

Starting in August 2017, multibeam antennas from the first small-scale production batch have been available for pilot users to test their performance in practice. Pilot users also have the opportunity to actively shape the last stage of product tweaks in line with their requirements prior to the antenna's market launch.

**Fraunhofer IIS**

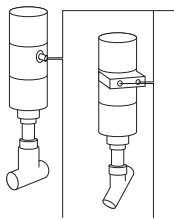
[www.iis.fraunhofer.de/en.html](http://www.iis.fraunhofer.de/en.html)



# Process automation with ingenuity

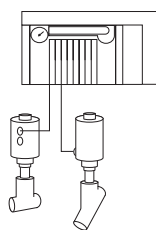
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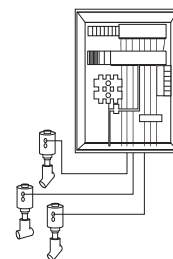
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**FUNCTIONAL SAFETY PROGRAMMABLE LOOP DISPLAY**

Moore Industries has released the SIL 3 capable SLD Functional Safety Programmable Loop Display for use in safety instrumented systems (SIS). The SLD has been certified by exida with full functional safety approval after rigorous evaluation to ensure conformance with the IEC 61508 standard for safety-related applications.

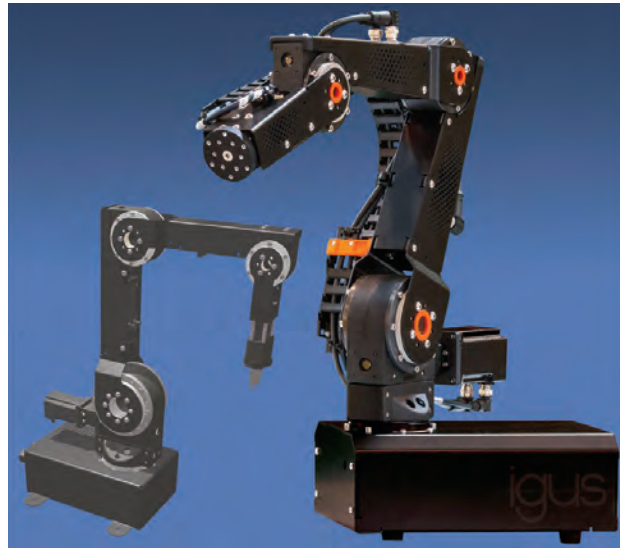
The SLD is part of the FS Functional Safety Series range and the loop-powered SLD displays real-time process status in mA, per cent or any designated five-character engineering units. Built for safety instrumented functions (SIF), the SLD can be taken out of the loop with the -LMD (loop maintenance diode) option without affecting the integrity of the safety function.

The loop display is DTM programmable with user-oriented basic configuration for fast and accurate set-up. The SLD can be programmed with any FDT-compliant host or program, such as PACTware, utilising Moore Industries' DTM and USB communication cable. DTM programmability allows the SLD to be custom-scaled to display per cent or scaled directly in engineering units to show process measurements such as pressure, temperature, level or flow.

It is loop-powered using less than 2.3 V, includes robust RFI/EMI protection, and has an easy-to-read display with two rows of large characters. With 360° mounting, the SLD can be mounted at any angle in almost any environment using one of the Moore Industries' explosion-proof and flameproof housings.

The SLD has a high accuracy reading for any 4–20 mA signal, displaying information with an accuracy of ±0.012% of input scale.

**Moore Industries Pacific Inc**  
[www.miinet.com](http://www.miinet.com)



**MODULAR ROBOTS**

Motion plastics company igus has announced new robolink components for individual robotics solutions. In addition to complete robotic arms in optimised design for more freedom of movement, higher stability and up to eight kilograms of load, igus has launched 'robolink designer', with which users can configure their robotic arms easily and quickly.

With the robolink range, igus is offering cost-effective components made of lubrication-free and maintenance-free plastics, so that users can assemble their systems individually from joints using a wide variety of gears, motors and connecting elements — either with individual components in self-assembly or with a fully preassembled articulated arm.

A 5-axis robot kit with optimised design is now available, which is also available as a finished, preassembled arm. The ready-to-connect robotic arm offers even greater freedom of movement and greater stability than previous products. igus is offering complete solutions with either four or five degrees of freedom in two different sizes.

With the 'robolink designer', users can select their specific components step by step on an intuitive CAD interface, thus enabling them to configure their robotic arm quickly and easily from the first axis up to the tool. The length of the arm is variable, so that the robot can be adapted to the respective work area. The software can also be used on a tablet, allowing, among other things, a visual simulation of movements on the rotating joints. Following the configuration, the software creates a parts list and a direct purchase request to igus.

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## NEW PRODUCTS

### **SYSTEM FOR MONITORING PULP FIBRE PROPERTIES**

ABB has launched L&W Fiber Online, an online system for measuring, monitoring and controlling significant fibre quality variables in paper stock preparation and pulp production. This helps pulp and paper customers to save production costs by optimising fibre usage, as well as reducing energy consumption through elimination of overrefining, and to improve quality by generating uniform pulp furnish for the paper, board or tissue machine.

Compared with traditional indirect measurements such as Canadian Standard Freeness (CSF) and Schopper-Riegler (SR), the measurements based on fibre images provided by L&W Fiber Online are said to provide more detailed information on the status of pulp quality. Fibre properties are categorised and presented as mean values and statistical distributions of width, length, shape factor, two classes of fines (P and S) and macro fibrillation.

L&W Fiber Online mitigates the problem of detecting late in the production process quality issues caused by fibre variations. By discovering variations earlier in the process — as early as in stock preparation — it becomes feasible to take corrective action in time to produce paper, board or tissue that meets the specifications. The system also allows for multiple sampling points with a single instrument, reducing initial investment and ongoing maintenance costs. For mixed furnishes, the optional Blend software analyses the ratio of reference fibre species in a fibre mix, making it possible to save raw materials when switching grades or during start-up.

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### **OIL CONDITION SENSOR FOR INDUSTRY 4.0**

One of the advantages of Industry 4.0 is the combining of cutting-edge information and communication technology into systems that are able to predict failure and ensure the wellbeing of a system. With oil-driven systems (eg, hydraulic or lubrication systems), oil analysis is key to predicting failure of the system. Oil samples are usually gathered in an oil sample bottle and sent to a lab for analysis. Now online sensors are available that are able to gather key data on oil condition and make this information available immediately to higher level systems.

The HYDAC Lab HLB 1400 is a multifunctional sensor for online condition monitoring of oils. The user is informed in real time of changes in the fluids and can take immediate action in the case of deteriorating operating conditions. Assertions can be made about the condition of the oil, such as ageing or mixing with other fluids, on the basis of the measured values for the relative change in conductivity of the oil, the saturation level and the temperature.

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## SURFACE ACOUSTIC WAVE FLOWMETER

The food, beverage, pharmaceutical and cosmetics industries require flowmeters that not only operate with high precision, but also meet strict standards and legal requirements with regard to hygiene and cleaning.

The Bürkert FLOWave Type 8098 flowmeter operates using the SAW process (surface acoustic waves), which uses surface waves to perform measurements. The primary advantage of this process is that there are no installed fittings or constrictions, which also means there are no empty spaces in the measurement tube. In addition, measurements are performed without any contact between the sensor elements and the medium. This is not only hygienic, it also simplifies the cleaning process and avoids pressure drops.

FLOWave consumes less energy than Coriolis flowmeters, for example, and can be mounted in any installation position. Measurements can be taken in standing liquids, fast-flowing liquids or liquid flows that change direction. In addition, no maintenance work is required, which can significantly reduce operating costs.

The compact flowmeter, manufactured entirely from stainless steel, measures the volume flow with an accuracy of 0.4% of the measured value. Temperature is measured simultaneously with an accuracy of  $\leq 1^\circ\text{C}$ . Depending on the orifice, the nominal pressure can be up to 25 bar. The temperature range is designed to enable CIP as well as SIP cleaning processes. The measuring device is available with tube orifices DN15, DN25 and DN40 as well as DN50, with tube and clamp connections according to ASME and ISO.

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The portable Olympus IPLEX NX is optimised for carrying out critical inspections efficiently in any environment. The videoscope produces vivid and clear images that can be viewed in any light, enabling users to identify even the most subtle defects. It is available to rent from TechRentals.

The IPLEX NX is designed to make precise 3D measurements, such as the depth of cracks, discovered through inspection. Multi-spot ranging is a feature that is designed to present real-time measurement of the distance from the scope tip to multiple points on the inspection surface. This feature provides details such as tilt of the target object and height difference of the surface in real time.

The videoscope can be configured to six different positions in order to suit the environment it is used in, enhancing the user experience. It features an intuitive 8.4" touch-screen interface, super-widefield stereo measurement and a tapered flex insertion tube. It can combine high-resolution still and MPEG-4 images.

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**INTEGRATED HART AND FACTORY AUTOMATION**

Beckhoff has introduced a platform to support both factory automation and process automation. This has been achieved by expanding its range of hardware and software by integrating process-specific protocols and interfaces, and by offering an extended range of products for hazardous areas.

The TwinCAT automation software now reduces development effort in process technology because it facilitates the application of comprehensive HART functions directly from the engineering interface. In this way, the TwinCAT FDT (Field Device Tool) container enables implementation of any field device drivers (DTM), allowing an entire HART configuration to be implemented efficiently using a single tool.

The Beckhoff CommDTM integrates the TwinCAT platform into existing process control systems and applies to all field devices connected



to HART-capable EtherCAT terminals. These devices can be configured and parameterised remotely without requiring direct PLC access. In addition, the Beckhoff OPC UA Server

and Client enable secure global distribution of process data, as well as convenient system control and remote maintenance capabilities.

The compact EtherCAT terminals in the Beckhoff ELX series are also HART-capable. With intrinsically safe I/O, they enable the direct integration of field devices installed in hazardous areas, Zones 0, 1 or 2, into an automation system. The reduced wiring effort and associated space savings result in an integrated, cost-effective solution for process applications. Furthermore, the CPX series of control panels and panel PCs makes the high-quality design and advanced multitouch display technology from Beckhoff available for locations subject to explosion hazards.

**Beckhoff Automation Pty Ltd**

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**NEW  
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## CYLINDER SENSORS

Balluff has announced the availability of teachable cylinder sensors for C and T slots.

For cylinders, grippers and valves a teachable magnetic sensor with two switch points can replace two standard sensors. For longer cylinders the additional switch point can be used for other purposes, such as for reducing the air pressure before the end-of-stroke position of the cylinder. IO-Link offers up to eight switch points along with individual hysteresis settings.

With a detection area of 60 mm, the BMF 235 sensor is best located in the middle of the cylinder offering the closest possible switch points. The teachable magnetic sensor for C-slots offers 10 mm more detection area than previously. In addition to eight switch points via IO-Link, the sensor features two teachable outputs.

Multiple connection options include PNP/NPN NO/NC and IO-Link PNP NO, with a 2 m pigtail cable with either an M8 or M12 connection.

**Balluff Pty Ltd**  
[www.balluff.com.au](http://www.balluff.com.au)

## DCS WITH PROFITABILITY CAPABILITIES

Schneider Electric has improved the capabilities of its EcoStruxure Foxboro DCS, the company's flagship distributed control system.

Historically, distributed control systems have been limited to controlling the efficiency and safety of the process, without being able to measure and control other critical operating variables — such as profitability — in real time. The EcoStruxure Foxboro DCS is designed to increase the business value process controllers can generate, primarily by making the real-time profitability of the operation more visible by providing built-in, customisable, real-time accounting (RTA) models. The RTA models can be manipulated and adapted to suit a variety of industrial operations across multiple segments, enabling a wide range of users to gain more value from their existing systems.

Along with the RTA models, the DCS is said to feature high-capacity, high-availability control processors; more powerful, fit-for-purpose I/O; intuitive, role-based engineering tools; and enterprise-wide analytical tools and capabilities. Additionally, its hardened cybersecure design and secure integration with the company's Triconex safety systems protect the facility's critical assets and allow for continuous production. Automated, enterprise-wide, real-time condition monitoring and predictive maintenance capabilities help minimise unplanned shutdowns, maximise uptime and may lower maintenance costs by 30% or more.

The DCS also works with EcoStruxure Profit Advisor, a software solution that applies the RTA models to help diagnose and analyse the profitability of processes throughout the plant.

**Schneider Electric**  
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[www.ProcessOnline.com.au](http://www.ProcessOnline.com.au)

**NEXT  
GENERATION**



## Max Out the New Multi Mini

Pilz has expanded its new PNOZ Multi range to include the new Multi Mini safety controllers. The new base units offer significantly better cost performance especially for machines that require a simple range of safety functions. But still providing a large array of customisation & expansion, to easily meet all customer safety requirements, especially when integrating it into any type of manufacturers standard control system or PLC.

- ▶ New compact PNOZ Multi mini Range
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- ▶ Huge range of different IO Expansion options
- ▶ Don't settle for second best because of your standard control system



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*John Dronette, Siemens*

# IS THE BELT SPEED ACCURATE ON YOUR CONVEYOR BELT SCALE SYSTEM?

The accurate weighing of bulk material on a conveyor is highly dependent on accurate speed sensing.

Continuous belt weighing is the process of determining the mass flow rate of bulk material being transported on a conveyor belt. It involves the determination of the instantaneous weight of the material on the belt and the linear speed of the belt. These two variables, determined separately, are brought together to produce flow rate or total weight.

In many cases, people have found that the conveyor belt speed used by their belt scale system controller does not match the belt speed when checked by another method. The reported difference has sometimes been as much as 5%. This can have a significant impact on the accuracy of the mass flow rate of the material.

There can be several factors that contribute to belt speed errors, including but not limited to:

- incorrect scale factors used to convert the speed sensor signal to the belt speed
- faulty speed sensors or speed sensor installation
- an error in the comparison method used to check the belt speed reported by the controller.

This article will focus on the first factor: incorrect scale factors used to convert the speed sensor signal to belt speed.





## Background

Many belt scale systems include two sensors: the load sensor, or the weighbridge, and the speed sensor. The signal sent from each sensor is sampled multiple times per second by the controller, or integrator. The integrator calculates the instantaneous rate output using this formula:

$$r = ls$$

where:

$r$  = instantaneous rate

$l$  = instantaneous belt load sampled from load sensor

$s$  = instantaneous belt speed sampled from the speed sensor.

The instantaneous rate output from the controller is one of the process variables of interest to the plant operator. The controller integrates the calculated instantaneous rate values over time to determine the total amount of product that has passed across the scale. Total production across the scale is another process variable that may be of interest to the plant operator.

From the above formula, it is reasonable to conclude that any error in the conveyor belt speed compounds any error with the

load signal. The first way to resolve a belt speed issue is to acquire the belt speed accurately prior to addressing any load sensor accuracy issues.

There are many types of speed sensors used on conveyor belt scales. The speed sensor is commonly coupled to the shaft of a non-drive pulley in contact with the conveyor belt at all times. The output signal is a square wave voltage pulse measured in hertz (Hz).

The belt scale system controller reads the frequency signal and rescales it to represent belt speed. The scale factor is called the 'speed constant'. Instructions on how to program the speed constant will be located in the manufacturer's user manual. The pulley circumference and the pulses per revolution (PPR) are the two variables that influence the speed constant. The PPR is listed on the nameplate for the speed sensor.

## Pulley circumference

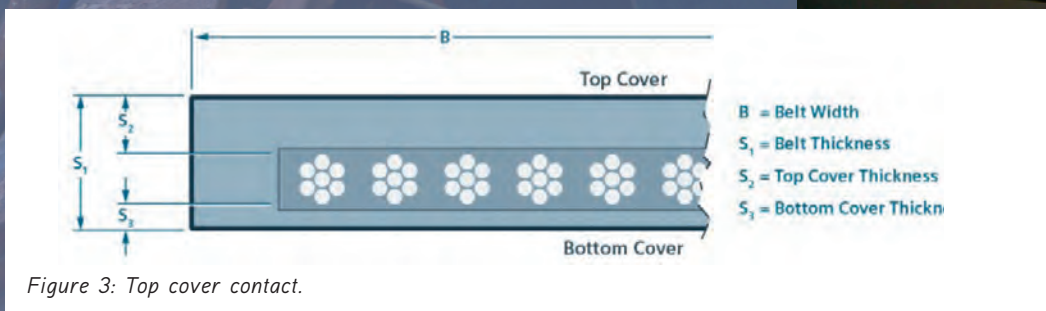
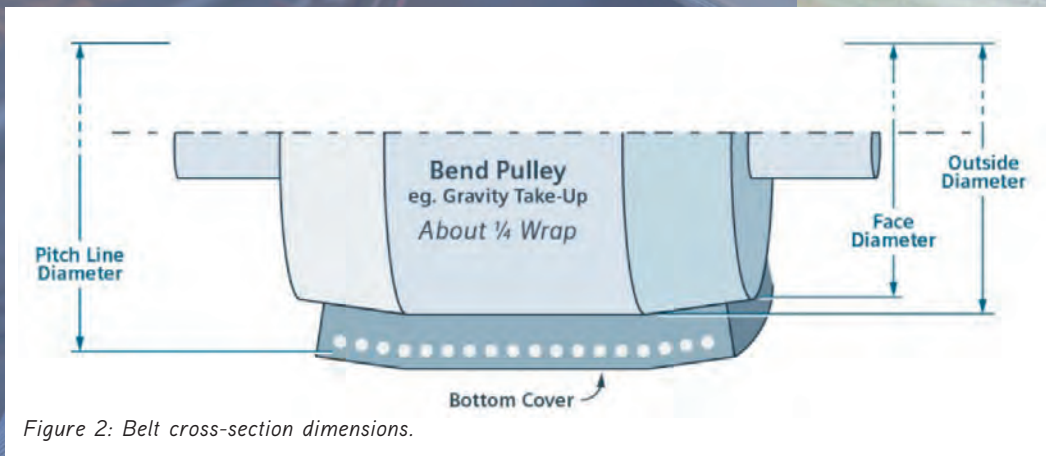
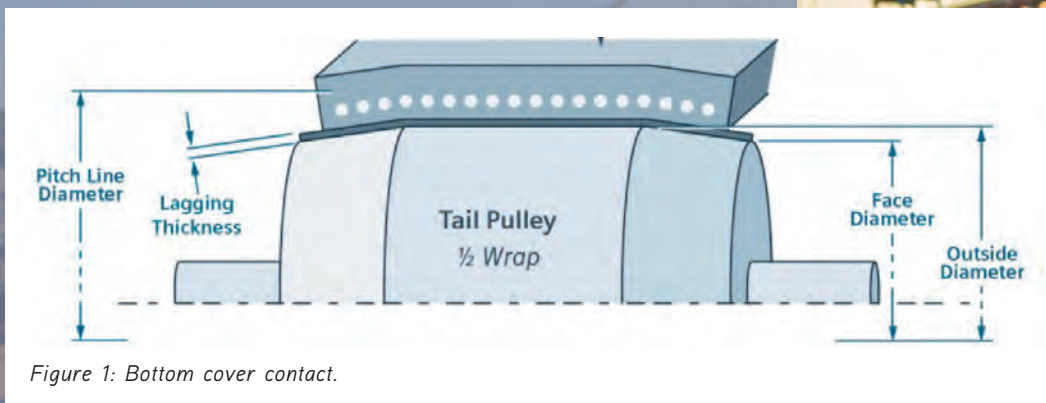
So the question is: what should be used for the pulley circumference?

Belt scale manufacturers recommend using the diameter of the coupled pulley to calculate the circumference. One may interpret this statement to mean the pulley diameter that is





THE FIRST WAY TO RESOLVE A BELT SPEED ISSUE IS TO ACQUIRE THE BELT SPEED ACCURATELY PRIOR TO ADDRESSING ANY LOAD SENSOR ACCURACY ISSUES.



measured at one end of the pulley or whatever diameter is listed on the conveyor specification sheet or drawing. But this may not always be accurate.

To ensure accuracy, we have to consider these points:

- Some non-drive conveyor pulleys are crowned to help track the belt. The diameter of the pulley is larger in the centre than it is at the ends (see Figures 1 and 2). The pulley circumference should be based on using the largest pulley diameter.
- One manufacturer's standard 'hydro-crowned' pulley is tapered 1/8" per foot of width on the diameter, or 1/4" maximum. The nominal pulley diameter is given at both ends and the pulley will have a larger diameter in the centre.
- The machined-crown pulleys from another manufacturer use 1/8" x 8" that tapers off the radius each end on pulleys wider than 24". The nominal pulley diameter is given at the centre and the pulley will be smaller at the ends.
- A belt manufacturer recommends using the 'pitch line diameter' for calculating the pulley circumference. The pitch line diameter is further explained to be the measurement taken at the centroid of the belt when it is wrapped around a pulley.
- The above belt manufacturer further explains that the centroid of the belt is where the belt is neither in compression nor tension when it is wrapped around a pulley. Since the belt carcass cannot stretch or compress, consider using the centre line of the carcass as the centroid distance. The calculation parameters are shown in Figures 1, 2 and 3.

Let's quantify the accuracy error by using the above points in an example.

### The effect of belt thickness

For example, consider the following parameters:

- Coupled pulley details: 406 mm diameter (16") by 965 mm wide (38"), machined crown, lagging 9.525 mm thick (3/8").
- Belt details: 914 mm wide (36"), two-ply, 38.5 N/mm (220 PIW), 4.76 mm (3/16") by 1.58 mm (1/16") SBR covers, with an overall thickness of 8.7 mm (11/32").
- The speed sensor is a 256 PPR encoder.

When the speed sensor is coupled to a pulley in contact with the belt bottom cover (Figure 1), the belt centroid distance from the bottom cover (shown in Figure 2) is:

$$d_b = S_3 + \frac{S_1 - S_2 - S_3}{2}$$

$$d_b = 1.58 + \frac{8.70 - 4.76 - 1.58}{2} = 2.76 \text{ mm}$$

When the speed sensor is coupled to a pulley in contact with the top cover, as per Figure 3, the belt centroid distance from the bottom cover is:

$$d_t = S_2 + \frac{S_1 - S_2 - S_3}{2}$$

$$d_t = 4.76 + \frac{8.70 - 4.76 - 1.58}{2} = 5.94 \text{ mm}$$

### Speed constant based on the pulley only

If the belt scale commissioning agent uses the circumference at the end of the pulley, then the circumference measurement may be based on as little as 400 mm (15¾") diameter for the pulley details given above when the lagging thickness is also ignored.

The speed constant is defined by:

$$k_s = \left(\frac{k_e}{\pi d}\right) \cdot 1000$$

where:

$k_s$  = speed constant (pulses per metre)

$k_e$  = encoder PPR (pulse per revolution)

$d$  = pulley diameter (mm)

Therefore, the speed constant for the example is:

$$k_s = \left(\frac{256}{400\pi}\right) \cdot 1000 = 203.7 \text{ pulses per metre}$$

### Effect of the belt

The pitch line diameter is given by:

$$d_{pl} = d_p + 2 \cdot (t_{lagging} + d_c)$$

where:

$d_{pl}$  = pitch line diameter

$d_p$  = nominal pulley diameter

$t_{lagging}$  = lagging thickness

$d_c$  = belt centroid distance

When the installation is as per Figure 1 and the pulley is in contact with the bottom cover:

$$d_{pl} = 406 + 2 \cdot (9.52 + 2.76) = 431 \text{ mm}$$

The speed constant is therefore:

$$k_s = \left(\frac{256}{431\pi}\right) \cdot 1000 = 189.1 \text{ pulses per metre}$$

This is a 7.7% difference from using the pulley alone for the calculation. The difference is even greater when the pulley is in contact with the thicker top cover:

$$d_{pl} = 406 + 2 \cdot (9.52 + 5.94) = 437 \text{ mm}$$

The speed constant in this case is therefore:

$$k_s = \left(\frac{256}{437\pi}\right) \cdot 1000 = 186.5 \text{ pulses per metre}$$

This is a 9.2% difference from using the pulley alone for the calculation.

So in these cases, any error in the weighing will be have an additional 7.7% or 9.2% error multiplier caused by using only the pulley diameter in determining the speed constant.

### Physical checking is necessary

The above analysis shows how much the reported belt speed can be affected by the method chosen for the calculation of the speed constant. In the real situation, it may not be practical to gather all the details needed to accurately calculate the circumference based on using the pitch line diameter. Hence, for most belt scale installations, it is prudent to have another method of checking the belt speed to compare with the belt speed detected by the controller.

It will be necessary to make adjustments to the speed constant in the controller, based on a secondary speed check as needed, to get the belt speed right prior to working on load sensor signal accuracy differences.

**Siemens Ltd**

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**PIPE SURFACE RESISTANCE THERMOMETER**

As a non-invasive measuring point, the model TR57-M pipe surface resistance thermometer from WIKA offers versatility, eg, in retrofitting or temporary fitting. The instrument, with its miniature design, can be fitted into space-critical surroundings.

The product is fixed to the pipeline using an adapter, with the electrical connection made via an M12x1 connector. A spring-loaded measuring insert ensures a constant contact for the probe with the surface. The probe tip is isolated against the ambient temperature by the silicon lining of the adapter.

The thermometer, with IP67 ingress protection, is designed for a measuring range of -20 to +150°C. It can be supplied with a direct sensor output or an integrated transmitter. The measuring insert can be removed for calibration.

**WIKA Australia**  
[www.wika.com.au](http://www.wika.com.au)

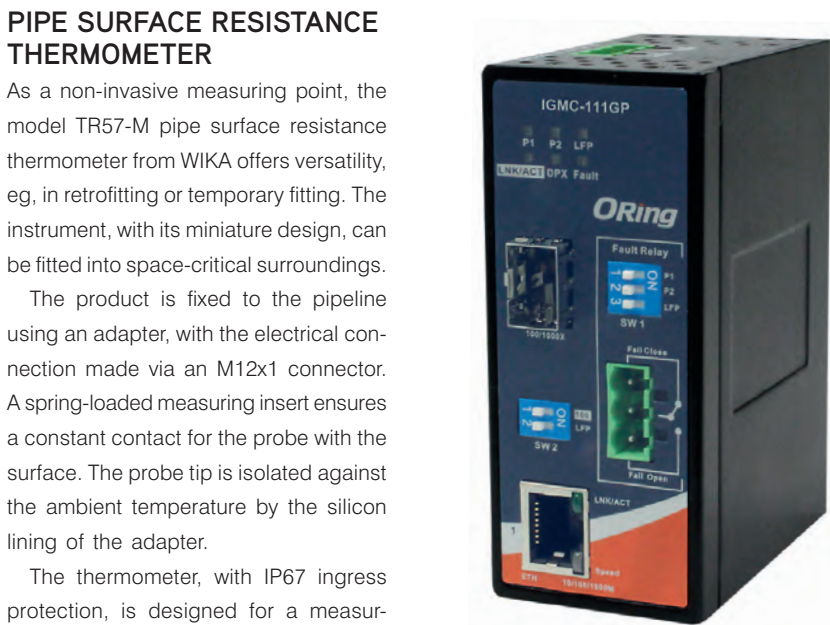
**STEPPER MOTOR CONTROLLER**

SMC has launched the JXC series of direct-input step motor controllers offering three additional communication protocols, namely DeviceNet, EtherCAT and Profinet, in addition to the EtherNet/IP fieldbus protocol that was available on previous models.

It is designed to directly control SMC's LE range of electric actuators, providing real-time, high-speed communication as well as added security due to dual-port I/O.

The direct-input step motor controller is designed for general machine builders who rely on accurate speed, position or force but at the same time look for improved flexibility and stronger security. The DLR option gives added security, as communication continues even when there is a disconnected element. In addition, real-time feedback is achieved through numerical data input, in addition to half-/full-duplex high-speed communication.

**SMC Australia | New Zealand**  
[www.smcworld.com](http://www.smcworld.com)



**GIGABIT ETHERNET CONVERTER**

The ORing IGMC-111GP Gigabit Ethernet converter is a robust media converter with a wide operating voltage, supporting all copper-side speeds and enabling user flexibility for a fibre interface via an SFP socket.

The product addresses local and interfaced device status through user-settable DIP switches that allow for Link Fault Pass-through (LFP). LFP allows an interface on either side to shut down the opposing side in the event of a connected device stopping transmission. Unlike most converters, this valuable feature enables instantaneous user alerts through link loss or via custom user settings with the connected equipment.

With a wide temperature range of -40 to 75°C, the device is suitable for harsh environments. It provides a 10/100/1000Base-T(X) auto-negotiation port and auto-MDI/MDI-X copper port as well as a 100/1000Base-X SFP fibre port. Jumbo frames (up to 9 KB) are supported and a fault relay output is provided. The unit has a rigid IP30 housing design with DIN rail or wall-mounting options.

**Control Logic Pty Ltd**  
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### GPU COMPUTING PLATFORM

The Nuvo-6018GC is an industrial-grade GPU computer supporting high-end graphics cards. It is designed to fuel emerging GPU-accelerated applications, such as artificial intelligence, virtual reality, autonomous driving and CUDA computing, by accommodating an NVIDIA GTX 1080 or TITAN X GPU.

Leveraging the Intel C236 chipset, the product supports Xeon E3 v5 and 6th generation Core i7/i5 CPUs with up to 32 GB ECC or non-ECC DDR4 memory. It incorporates standard computer I/Os such as Gigabit Ethernet, USB 3.0 and serial ports. In addition to the x16 PCIe port for GPU installation, the device further provides two x8 PCIe slots allowing for additional devices for information collection and communication.

The product is designed to handle heavy power consumption and power transients of a 250 W GPU. Furthermore, to have reliable GPU performance for industrial environments, the computer inherits Neousys's tuned cold air intake to effectively dissipate the heat generated by the GPU. This design ensures operation at 60°C with 100% GPU loading and makes the product suitable for demanding field usage.

The unit also features dual DVI display outputs, four 2.5" SATA drives with RAID 0/1/5/10 support, temperature sensing and automatic fan control. The operating temperature range is -25 to +60°C.



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The mechatronic circuit breaker type EBU provides selective overcurrent protection in AC 230 V UPS systems. The unit consists of an MCB approved for short circuit interruptions up to 10 kA.

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**COMPACT EQUIPMENT BUILDER IPCs**

Advantech is launching a series of rackmount IPCs featuring a small footprint, simple manageability and easy maintenance. These machine builder IPCs feature short depth, self-diagnosis, remote manageability and modularised design.

Machine builders can easily integrate the IPC in an equipment enclosure, leaving more space for cable routing and internal devices. Once installed, the IPC reports its status to a remote administrator before failure occurs, saving on-site inspection costs and reducing risk of unexpected downtime. Service staff can quickly swap key modularised parts, minimising maintenance time.

ACP-2020 and ACP-4020 both feature a short depth (400/350 mm) and a built-in Intelligent System Module that controls a smart fan, checks the IPC fan speed and temperature, and proactively reports any abnormal condition. The front-accessible system fan, hot-swap drive bay and redundant power module facilitate quick maintenance.

IPC-603 and IPC-631 also feature a short depth (308/350 mm), and all I/Os are on the front where the user can easily access all cables, connectors, AC inlet, buttons and LEDs. The IPC-631 also supports a hot-swap drive bay and redundant power supply, which make cable routing and maintenance much easier.

The ACP-4D00 features a depth of 350 mm and a dual-node design; it encloses two independent IPCs in a rigid 4U cage. Each node has two expansion slots and can be configured independently for different tasks. For example, one as a controller and the other for frame grabbing and image analytics.

**Advantech Australia Pty Ltd**  
[www.advantech.net.au](http://www.advantech.net.au)



**UNIVERSAL TEMPERATURE TRANSMITTER**

The Krohne OPTITEMP TT 33 C/R is a universal 4–20 mA temperature transmitter to be used with RTD and TC sensors. Available in head-mounted (TT 33 C) and rail-mounted (TT 33 R) versions, the product was designed according to the latest standards and user requirements, such as convenient configuration and safety over time. It is aimed at all industries that use process temperature assemblies in standard applications in harsh environments, such as chemicals, power generation, iron and steel.

Using Krohne's ConSoft software, the 4–20 mA device can be easily configured from a PC in hazardous areas. Over its lifetime the transmitter provides a measuring accuracy of  $\pm 0.08^\circ\text{C}$  or  $\pm 0.08\%$  of span, and a drift of  $\pm 0.01^\circ\text{C}$  per  $1^\circ\text{C}$  or  $\pm 0.01\%$  of span per  $1^\circ\text{C}$ . This low-temperature drift makes regular calibration less necessary.

In terms of safety, the product is compliant to NAMUR recommendations (NE) 21, 43, 53 and 107, and features ATEX and IEC Ex approvals. Due to a robust construction, external influences such as ambient temperature, vibration (up to 10g, as may occur in OEM/machinery applications), moisture and electromagnetic waves are negligible.

The transmitter can provide correction for the measurement error of the system consisting of either the sensor itself or sensor and transmitter together. It also features a run time counter, tracking and backup of previous configuration, an ambient temperature log, and an output simulation for loop testing.

**KROHNE Australia Pty Ltd**  
[www.krohne.com.au](http://www.krohne.com.au)



## MODULAR LIQUID ANALYSERS

The S80-T80 range of modular liquid analysers from Electro-Chemical Devices (ECD) is covered by international certifications for CSA, FM, IECEx and ATEX, with various hazardous location type design approvals available.

ECD's S80 sensors measure pH, ORP, pION, dissolved oxygen, turbidity, conductivity or resistivity in liquid processes. They are suitable for applications in many industries, including biotech, chemical, food and beverage, pharmaceuticals, power generation, semiconductors, water disinfection and wastewater treatment.

S80 sensors feature two universal sensor designs: insertion/submersion or valve retractable with a flared end to prevent blowout. The sensors are manufactured with a rugged 1.9 cm OD 316 stainless steel body and come with varying cable lengths or an optional waterproof detachable cable assembly.

The design of the sensors recognises the universal T80 transmitter for automatic configuration set-up. They can be combined into a complete plug-and-play analyser system for any of the available measurement parameters.

The T80 universal transmitter is a single-channel device designed for the continuous measurement of multiple parameters. It communicates with any precalibrated S80 sensor and automatically configures the transmitter's menus and display screens to the measured parameter.

The universal transmitter offers membrane switch navigation and a menu structure with soft key menu choices. It is available with 4–20 mA output with Modbus RTU on 24 VDC and 110/220 VAC instruments. The T80 can be configured with optional HART 7 communications and an optional three-alarm relay.



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**PLANETARY GEARBOXES**

Bonfiglioli's 300M range of planetary gearboxes are said to achieve greater torque, without increasing the size of the gearbox, to produce greater performance and efficiency for industries such as bulk materials handling, mining process equipment, food and beverage, materials handling, water treatment and waste handling.



The 300M series has eight sizes from 310M to 318M, all of which have a significant improvement in torque over preceding models. Depending on the size, torque has been improved by up to 45%.

One of the improvements in the series is the addition of a better bearing design. The series uses a customised roller design with an inner race on the pin and an outer race on the planet gear. This creates a bigger roller diameter, with a higher load capacity and greater torque.

The 300M series is completely interchangeable with the existing 300 series gearboxes. No machine modification is required when upgrading to the latest units.

**Bonfiglioli Transmission Pty Ltd**  
[www.bonfiglioli.com.au](http://www.bonfiglioli.com.au)



**SERIAL DEVICE SERVERS AND GATEWAYS**

Phoenix Contact has released

a range of device servers and gateways that make it easy to integrate serial devices in Ethernet-based automation networks. The increasing digitalisation and networking of production systems requires protected transmission. To achieve this, 256-bit AES data encryption has been implemented in all devices.

In addition to the transparent conversion of ASCII serial data into Ethernet datagrams, the gateways allow for the integration of serial devices with Industrial Ethernet protocols such as Modbus/TCP or EtherNet/IP. For flexible use, devices are available with one, two or four serial ports, and with one or two Ethernet connections. The integrated switch supports easy networking with other Ethernet devices. Several serial devices can be easily connected to a device server and integrated in an automation network.

**Phoenix Contact Pty Ltd**  
[www.phoenixcontact.com.au](http://www.phoenixcontact.com.au)



**MELT PRESSURE TRANSMITTERS**

The DYNISCO SPX-T (3-Series) melt pressure transmitters with a 4–20 mA output offer DYNISCO's DynaLarity feature that delivers accurate pressure measurement under high processing temperatures, and greatly improves pressure measurement errors even at low pressure.

The SPX-T melt pressure transmitter is capable of eliminating thermal zero shift, a common problem with melt pressure transmitters, where their measured pressure output varies at low pressure between a cold extruder, and elevated running temperatures once operational.

Temperature compensation is based on an internal RTD measurement that compensates for temperature variations, which in turn reduces temperature-related drift and increases accuracy, so that there is no need to re-zero for temperature changes after installation.

The SPX-T uses an advanced algorithm that will linearise offsets due to process effects on the sensor.

The combination of temperature compensation and DynaLarity is said to reduce temperature-related drift by as much as 80% and improve accuracy by more than 60% over other sensors.

Process pressure as well as temperature output is standard along with support for HART communication.

All SPX 3-Series models offer  $\pm 0.15\%$  accuracy and are available in a wide selection of pressure ranges. They have a turndown ratio of 6:1 and are remotely configurable via HART, and configurations are available for use in hazardous locations.

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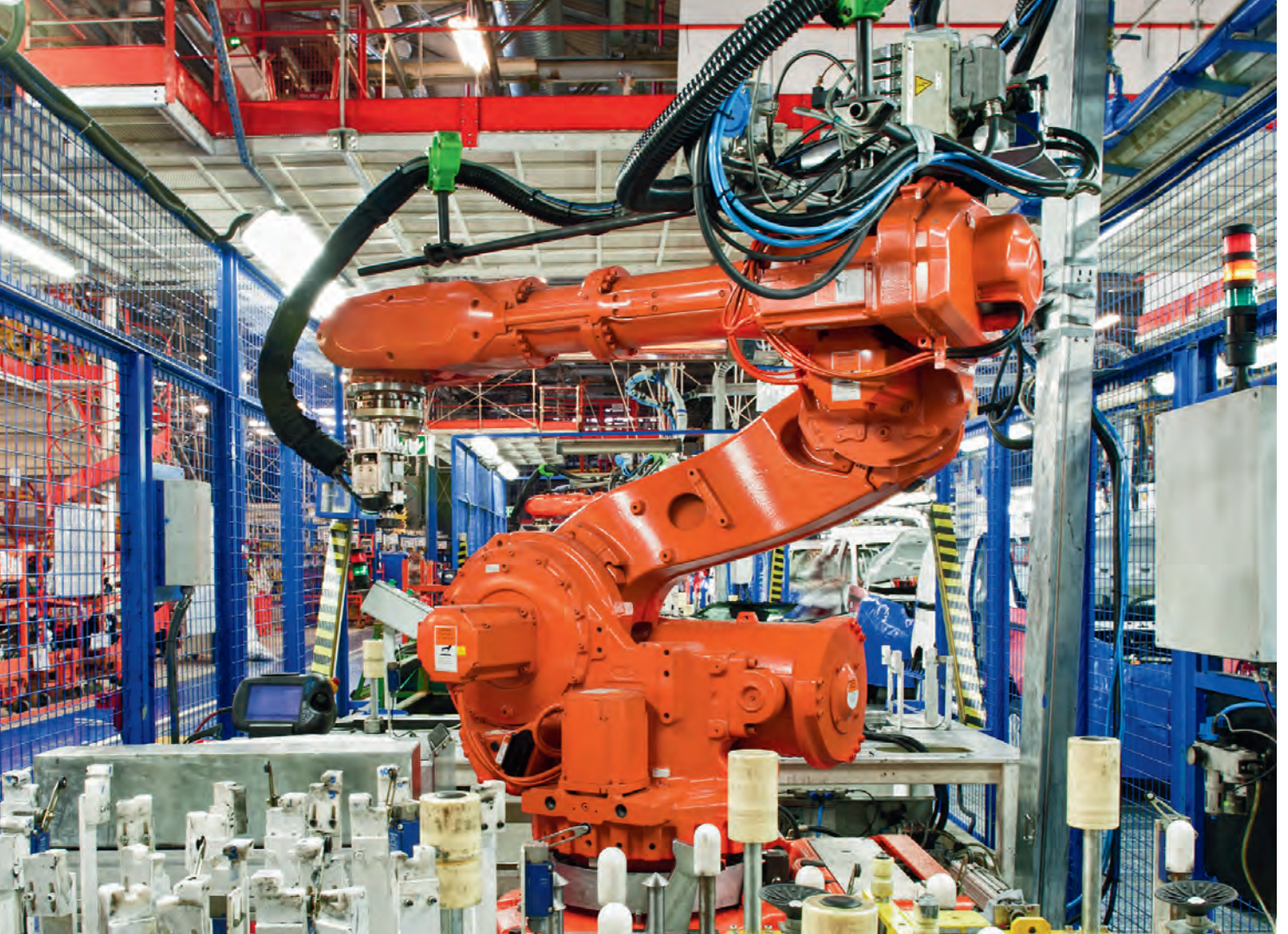
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# THE NEW INDUSTRIAL REVOLUTION

## ROBOTS ARE AN OPPORTUNITY, NOT A THREAT

David Flynn and Valentin Robu, Heriot-Watt University\*

If robots and AI are our future, we need to embrace the technology and work out how best to collaborate and make it work for everyone.

Invasion. Takeover. These are the kind of words that have been bandied about in news headlines about robotics and artificial intelligence in the last few years. The coverage has been almost relentlessly negative, focusing on the threat to jobs, squeezing out the human component. While such potential is there, if robotics and AI do become a threat, then we believe this would be a threat of society's own choosing.

The market impact of robotics and autonomous systems is estimated to be US\$9.8 to US\$19.3 trillion a year by 2025, but a recent report from the Sutton Trust stressed concerns that this could lead to a two-tier society with:

*An elite high-skilled group dominating the higher echelon of society and a lower-skilled, low-income group with limited prospects of upskilling and hence upward mobility, resulting in a broken social ladder.*

Technical innovation has always had an impact on the status

quo and stirred fears of what change might bring. Currently the fear is that the owners of the means of production will become rich, while other will see their jobs and livelihoods taken by robots.

### Living in a connected era

The revolution in robotics and autonomous systems has already begun. We live in a connected era where affordable technology interacts with us and with other natural and physical assets in our environment, turning data into information for a global audience.

AI has the ability to bring expert knowledge to the lay person remotely, that is, anywhere in the world, and support them in their endeavours like a virtual mentor, customising information in a useable format they can engage with. And by giving people this knowledge it offers unprecedented opportunities ranging from garden shed innovators gaining access to manufacturing processes which would previously been beyond their reach, to the potential for wealth creation in countries that are most in need of it.

For example, AI is helping communities in developing nations implement local renewable energy systems by providing intelligent automation and monitoring – almost like an online “doctor”, making



sure the system is “healthy” and working properly. This means communities not only gain access to affordable and sustainable energy but can also engage in trading of any surplus energy to other consumers or utility companies.

But to achieve these benefits society has to be ready to grasp them. Governments, business and academia all have a responsibility to prepare the current and future workforce for the imminent and dramatic changes to come, and society as a whole has to buy into this new industrial revolution.

Contrary to the perceived apocalyptic scenario, we believe the future is all about people: after all, the value of technologies is in the knowledge we humans embed within them and how we interact with them, not the machines themselves. For that human-based scenario to work we need an agile, future-ready workforce, ready to embrace a data-driven world in partnership with robotics and autonomous systems.

An existing example is the Siemens “lights out” manufacturing plant in Amberg, Germany, which is automated to the point where some lines can run unsupervised for several weeks. This is viewed as a stepping stone towards a fully self-organising factory that would allow the manufacture of highly customisable products. Yet this automated factory has 1,150 employees supporting it, just with different roles focused on programming, monitoring and machine maintenance.

### The new industrial revolution

Since the first industrial revolution people have generally had to follow the technology, moving to the big cities or from developing nations to developed countries, to improve their access to the opportunities offered by technology.

At Heriot-Watt we are embracing both the newest technological opportunities and the challenges that they bring. Our work involves engaging with government and industry around a people first ethos via our Centre of Embedded Innovation (CEI) concept, which is reaching out to all of our communities to enable access to the latest advances in data analysis, robotics and autonomous systems.



*The rise of robots in industry means we must look at new ways of working and collaborating with them.*

Studies by the Sutton Trust have indicated that in the past decade in the UK, the gap between rich and poor in society has increased, with inequality now at a record high. The CEI seeks to address this societal imbalance through making opportunity more equal, in which education plays the key role, and helping to create a new “embedded” industrial revolution which supports business and economic growth, transferring knowledge and resources to those communities most at risk of poverty.

Wealth creation and innovation must be centred on people to achieve a prosperous future that is inclusive throughout society. It’s also clear that the speed of this industrial revolution warrants a transformative change in strategy through government, industry and academia.

*\*David Flynn, Associate Professor, Embedded Intelligence in Energy Systems, Heriot-Watt University and Valentin Robu, Lecturer in Smart Grids, Heriot-Watt University.*

This article was originally published on *The Conversation*.

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### PLC FOR CONTROL OUTSIDE THE CABINET

Turck has released its TBEN-PLC CODESYS 3 compact IP67 PLC for controlling small or modular machines. Due to its robust housing and high degree of environmental protection, the TBEN-PLC can operate directly on-machine, enabling the implementation of machine control without the need for a control cabinet. Using machine automation concepts and the use of preassembled cordsets reduces the cabling effort and simplifies installation.

A wide variety of fieldbus communication protocols are supported; when used as a master/scanner, the device supports the industrial Ethernet protocols Profinet, EtherNet/IP and Modbus TCP, as well as Modbus RTU, CANopen and SAE J1939.

The TBEN-PLC can also be used as a remote I/O device for Profinet, EtherNet/IP, Modbus TCP, Modbus RTU and CANopen networks, enabling use as a protocol converter or gateway. For example, the controller can function as a CANopen manager for a machine module and connect this local network to a higher level system communicating over Profinet. As part of the increasing digitisation of industry, this enables existing machine controls to be integrated into modern closely networked, highly flexible production systems.

Two onboard serial ports can also be used to integrate RS-232/485 serial devices. The device provides eight configurable discrete I/O channels for the direct connection of sensors and actuators. When combined with Turck's fieldbus technology products with IP67 protection, comprehensive machine control including safety technology can be completely implemented without the need for a control cabinet.

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### MEDIUM-VOLTAGE AC DRIVES

The Allen-Bradley PowerFlex 6000 medium-voltage AC drives, from Rockwell Automation, offer expanded, user-friendly control for variable and constant torque applications. They deliver a wide voltage range (2.4 to 11 kV), with 100% starting torque and sensorless vector control.

The drive is easy to commission, use and maintain, with standard faceplates and EtherNet/IP connectivity.

With an extended power range, the drive can be used for applications with output-voltage ratings up to 11 kV and motor current ratings up to 680 A, while remaining an air-cooled design. With eco-designed main cooling fans, users in IEC-based markets can meet EC regulation 327 and ErP directive 2009, and avoid the larger footprint of a liquid-cooled drive. Internally powered cooling fans reduce user-supplied control power requirements, as well as equipment and installation costs. A tertiary winding on the isolation transformer provides internal power for the fans.

Output-voltage ratings up to 11 kV are available for Australia and New Zealand. The full range of ratings includes 3.3, 6.6 and 11 kV.

With optional, automatic cell bypass up to 680 A, users can keep their operations running in case of a power cell failure and reduce unplanned downtime. In addition, an uninterruptible power supply helps minimise downtime and mitigate potential machine damage.

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### IBC DISCHARGER

Flexicon's BULK-OUT low-profile discharger positions intermediate bulk containers (IBCs) weighing up to 1450 kg in the frame using an electric hoist and trolley, discharges bulk solid materials into a surge hopper and conveys the material to a downstream process dust-free.

Lifting arms fitted with four eye hooks connect to the mobile IBC frame, which is equipped with four inverted cradle cups that mate with corresponding posts on the discharger frame for precise positioning of the IBC outlet. When lowered into position, the tapered outlet of the IBC's butterfly discharge valve mates with a gasketed receiving ring on the lid of a surge hopper, allowing opening of the valve and discharging of material with no dusting.

The surge hopper is available with an integral flexible screw conveyor, tubular cable conveyor or pneumatic conveying system also produced by the company.

The purpose-built stainless steel IBC hopper frame measures 914 mm square by 965 mm high and includes two swivel and two rigid castors with brakes. Quick-release clamps secure the hinged hopper lid during transport and discharge of material.

A port on the lid of the surge hopper is vented to a BAG-VAC dust collector that puts the sealed system under negative pressure, preventing displaced air and dust from entering the plant atmosphere. All material contact surfaces of the system are of stainless steel with the exception of the flexible screw conveyor's polymer outer tube.

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LAPP EXPRESS is operated by Engineering Computer Services (ECS), a New Zealand business that has a history of providing solutions to process and automation engineers for more than 30 years. With extensive experience as a leading authorised supplier of electrical and automation products across Oceania, the company has now extended its online offer to customers in Australia.

LAPP EXPRESS offers fingertip access to the latest technology innovations from Europe and around the world. Engineers always need to improve the way they do things; new products are always being developed which can save them time and money. For engineers using this website, it demonstrates with videos some of the latest innovations and gives them new ideas which they might not have seen from traditional suppliers.

With no MOQ's and fast delivery, an engineer can get a couple of pieces in for development of a proof-of-concept before committing to full production. The website also takes all major credit card brands, so there is no need to raise an official purchase order if you just want to try something out quickly.

LAPP EXPRESS' behind-the-scenes customer service team is made up of trained electricians and automation engineers who understand customer needs. It employs highly trained engineers with real world industrial experience, so customers can have confidence in its advice. Engineers are able to live chat or free phone at any time to speak to the support team about the right products for their application. This coupled with online rich product information for each product including technical datasheets, installation instructions and demonstration videos, makes it easy for an engineer to find and select the right product first time.

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The website offers a unique feature called EXPRESS FIND. This menu function brings up the all previous product purchases, when it was last purchased, the pricing and the current stock availability. With other websites when users re-order a repeat product they need to drill down through all the product hierarchies again, and there is always the doubt in the back of ones mind it might be a different item than expected. With EXPRESS FIND users know this is the identical product they had last time, and allows for one-click reordering, saving time.

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**NEW  
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## OIL-FREE COMPRESSORS

With the launch of the S-Series scroll compressor range, CompAir has further extended its PureAir range of oil-free compressors, which now cater for application requirements in the 4 to 15 kW range.

Air purity is crucial in a variety of industries, ranging from food production and pharmaceuticals to electronics and biotechnology.

With its compact design and low-noise operation, the S-Series of compressors is suitable for ensuring full protection from contamination and to meet the demands of sensitive environments such as laboratories and hospitals.

The S-Series provides continuous, low-maintenance operation to meet a variety of flexible compressed air demands. Available in a range of sizes, starting at 4 kW for simplex units and 7 kW for duplex units, the scroll compressor series is capable of delivering a volume flow between 23.6 and 106 m<sup>3</sup>/h at 8 bar and 21.2 to 82.6 m<sup>3</sup>/h at 10 bar.

The series can also be installed with the optional Deluxe HMI control panel. With an intuitive and easy-to-use graphical user interface, the Deluxe HMI control panel provides users with real-time information such as system runtime meters, maintenance timers and discharge pressure/temperature statistics. An integrated web server utilises Modbus TCP over Ethernet, which allows users to monitor the units from any internet-connected computer, smartphone or mobile device.

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## RUGGED TABLET COMPUTER

The Aaeon RTC-700M rugged tablet computer has been designed to meet the IP65 and MIL-STD 810G standards, making it resistant to moisture, dust, shock and vibration.

The product features the TI OMAP 4470 1.5 GHz dual-core processor with 1 GB of LPDDR2 memory. A 7" 1280 x 800, 400 nits LCD with a capacitive multitouch screen provides the user interface. Onboard communication includes WLAN 802.11b/g, Bluetooth and an optional 3G modem module.

Additional I/O includes a Mini-USB port, a Mini-HDMI port and a MicroSD card slot. Built-in features include a rear 5 MP camera, a G-sensor, a light sensor, an eCompass, GPS navigation, a speaker and a microphone.

A high-performance lithium-polymer high-capacity battery provides 8 h of operation.

The device is supplied with the Android 5.1 operating system.



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## FLOW SWITCH

The FLT93 Series flow switch from Fluid Components International is designed to provide a solution to relief valve leak monitoring that keeps natural gas fractionation facilities safe without the inconvenience of false alarms that interrupt operations.

In CSG fractionation process facilities, a flow switch is typically installed after the pressure relief valve and alarms if there is flow. Should the flow switch alarm due to gas being released through the relief valve, it indicates via a dry contact that there is an event in progress.

The FLT93L flow switch is a heavy-duty thermal dispersion flow, level and temperature switch designed with an all-welded thermal sensing element and a control circuit that is field-configurable to satisfy any combination of application requirements. The thermal sensor in the switch makes it suitable for both gases and hydrocarbon-based liquids.

The switch's voltage output allows the user to 'see' into the process and set the desired trip point. The delta range between the switch's two RTDs provides a span for setting the switch trip points. Flexible dual 6 A relays are settable by the plant technician for any combination of flow, level or temperature alarms.

With a flow accuracy of  $\pm 2\%$  of the setpoint velocity over a  $\pm 28^\circ\text{C}$  temperature range, and a repeatability of  $\pm 0.5\%$  of reading, the switch meets the needs of CSG applications. Temperature compensated and SIL-2 rated, the complete instrument offers Ex agency approvals FM, FMc, ATEX, IECEx, Inmetro and TR CU.

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## PANEL PC

ICP Electronics Australia has released IEI Integration's 19" industrial metal bezel panel PC, the PPC-F19B-BT.

Powered by the Intel Celeron J1900 quad-core SoC, this heavy industrial panel PC can support up to 8 GB of DDR3L SO-DIMM RAM.

It features a 19" LCD screen and a robust, ultraslim aluminium front bezel equipped with a 5-wire resistive touch screen. The full-function LCD panel PC features multiple I/O ports including two Gigabit LAN ports, two USB 3.0 ports, two USB 2.0 ports, two RS-232 serial ports, an RS-232/422/485 port and an audio connector.

The product meets the IP65 rating, providing resistance to dust and liquid ingress. It also offers one full-size and one half-size PCIe Mini slot for expansion opportunities. The operating voltage is 9–30 VDC.

**ICP Electronics Australia Pty Ltd**

[www.icp-australia.com.au](http://www.icp-australia.com.au)

## DIFFERENTIAL PRESSURE TRANSMITTER

The Series 629C wet/wet differential pressure transmitter monitors differential pressure of air and compatible gases and liquids with 0.5% accuracy. The design employs dual pressure sensors converting pressure changes into a standard 4–20 mA output signal or field-selectable voltage. Small internal volume and minimal moving parts result in fast response. The terminal block, as well as a zero adjustment button, are easily accessed under the top cover. The Series 629C differential pressure transmitter is designed to meet IP66 requirements.

It can be powered by either DC or AC, and the optional LCD display for local status indication does not need a separate power supply. A selectable voltage range provides flexible choice for changing design or inputs for process/HVAC controllers. The push-button zero (versus trim pot) provides more simple zeroing, reducing installation time and the possibility of operator error.

Applications include flow elements, heat exchangers, filters, coils, chillers and pumps.

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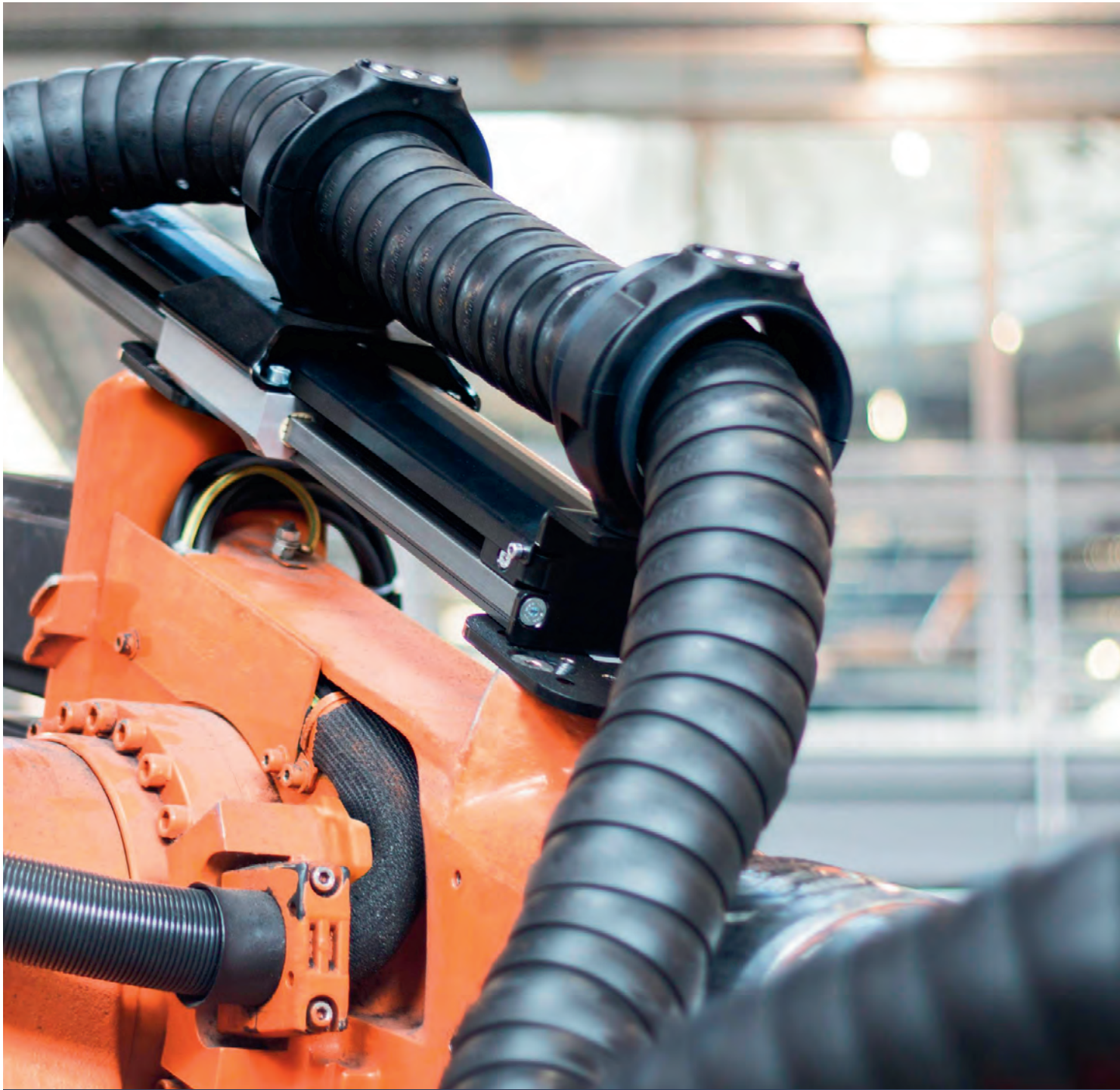
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# THE LESS-IS-MORE APPROACH TO ROBOTIC CABLE MANAGEMENT

Cable issues have been cited as the number one reason for downtime in robotics cells, so the way in which robot cables are attached and guided is important for robot reliability.

In recent years, cable management has come into the limelight because machine reliability has increased dramatically, even though robots have grown more complex. Unfortunately, the methods used to attach and guide cables have not quite followed suit. While managing cables and hoses is often an afterthought in most designs, it is truly a vital part of any well-functioning robot.

Since the 1960s, cable management methods for robots have not changed dramatically. Most experts agree that one of the top blunders made is underestimating cable management issues. For instance, during a conference hosted in 2008 by the Robotic Industries Association (RIA)<sup>1</sup>, a group of leading system integrators cited cable issues as the number one reason for downtime in robotics cells. Headaches range from tangled and corkscrewed cables to complete breaks that cause downtime, lost revenue and damaged reputations.

This is why the ways in which robot cables are attached and guided is important. The less-is-more approach to cable management is a best practice that robotics engineers and integrators can apply. It centres on designing cable management systems for six-axis robots — including cables, hoses, tubing, carriers and connectors — in three separate sections.

### Overview of industrial robots

The term 'robot' is defined as a machine capable of carrying out a complex series of motions automatically. It was first introduced in a Czech science-fiction play; then, in 1942, the term 'robotics' was coined by Isaac Asimov, a well-known American author and professor of biochemistry at Boston University.<sup>2</sup>

By the 1970s robotics had made its way into most manufacturing facilities, predominately in the automotive industry, and by 1980 more than 4000 robots were being used in the US. Fast forward nearly 40 years, and more than 2.6 million industrial robots are predicted to have made their way into manufacturing plants throughout the world.<sup>3</sup>

During the evolution of robotics, many different types of robots emerged. Some of the most common are:

- **Cartesian (gantry or linear):** rectangular arms described as using x, y or z axes.
- **Spherical (polar):** one linear axis and two rotational axes around the vertical shoulder joints.
- **Jointed-arm (6-axis articulated):** rotating shoulder and elbow in horizontal axes.
- **SCARA (selective compliance assembly robot arm):** special jointed-arm version.
- **Cylindrical (post-type):** three degrees of freedom, y and z linear movements, rotating base.

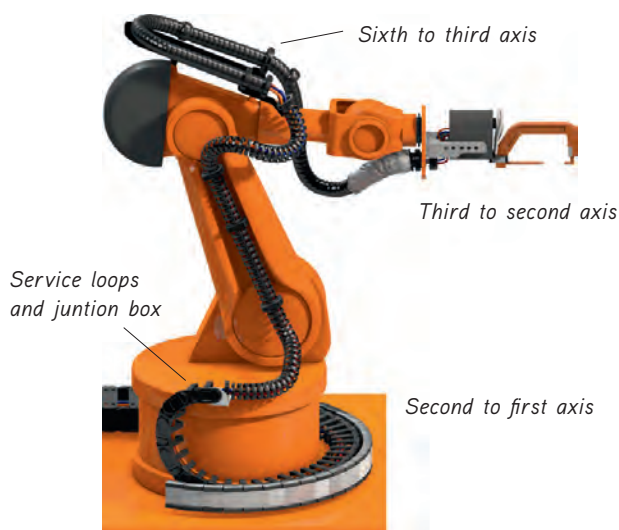


Figure 1: Dividing the robot into three separate sections.

What do all these robots have in common? The cable management system is typically left to the last minute, but without it, unprotected cables are likely to fail. Cable damage can shut down the most important robot on the line, which leads to costly downtime.

### The less-is-more approach for six-axis robots

Current systems try to keep the cables on a six-axis robot static while everything operating around them is dynamic. Using one, long restrictive cable package prevents movement in sync with the robot. Restrictions stress cables, which accelerates failure. Often technicians severely bind cables with excessive dress packs (protective coverings on cables), cable ties and even duct tape. The goal is to minimise tangling and interference with the machine, but these types of solutions cause corkscrewing and failure.

Instead, consider a six-axis robot as three separate sections:

1. The sixth to third axis.
2. The third to second axis.
3. The second to first axis.

This breakdown is the key to longer-lasting cables. Each cable section needs a minimal dress pack, strain relief with service loops, and a junction box that contains and protects the electrical connectors joining the cables.

Use of a strain relief mechanism can eliminate stresses and extend the service life of a moving cable. This strain relief may consist of standard elements such as tie wrap plates or clamps. Engineers should ensure the cables are in the neutral axis, not touching the inner or outer radius of the cable management system.

From the sixth to third axis:

- Strain relief cables on the moving end (sixth axis) with a 30–60 cm service loop.
- Protect cables and hoses with a modular, multi-axis cable carrier.
- Separate cables at the third axis and install a junction box for diagnostics and cable replacement.





SEPARATING THE DRESS PACK INTO THREE SHORTER SECTIONS PREVENTS IT FROM WRAPPING, CATCHING OR SNAGGING ON MACHINES AND MINIMISES STRESS ON CABLES AND HOSES.



From the third to second axis:

- Strain relief cables on the third axis with a 30–60 cm service loop.
- Use a modular, multi-axis cable carrier.
- Separate cables and install a junction box at the second axis.

From the second to first axis:

- Strain relief cables on the second axis with a 30–60 cm service loop.
- Multi-axis, reverse bend radius (RBR) cable carrier, protecting and guiding rotating cables.
- Separate cables and install a junction box at the first axis.

Separating the dress pack into three shorter sections prevents it from wrapping, catching or snagging on machines and minimises stress on cables and hoses. This approach applies to any six-axis robot, regardless of manufacturer or application. While other fixes such as duct tape and ties wraps might cost less and work temporarily, in the long run, properly designed dress packs reduce unnecessary downtime and maintenance costs.

Six-axis robots can be found in applications such as general factory automation, welding, painting, machine tools, handling machines, packaging machines, and many more.

In addition to the appropriate dress pack, it is imperative that six-axis robots use dynamic cables specifically designed for continuous flexing. Two important features to take into account are a cable's torsion resistance and shielding. Shielded cables face a greater risk of failure because constant movements can easily compromise the cable jacket. Use unshielded, high-flex cables whenever possible to avoid problems. If this is not an option, turn to special 'rolling flex' cables.

## Cable management options

There are different options available for guiding and protecting cables on six-axis robots. Three well-known solutions include flexible tubing, enclosed dress packs and robotic cable carrier systems.

### Flexible tubing

Corrugated or flexible tubing is one option for protecting cables on six-axis robots and is available in a wide range of sizes and styles. It has superior tear resistance at connection points and a long service life, even with reverse bend cycles.

However, corrugated tubing has its limitations. It delivers minimal torsion resistance and can only be fixed at two points with a defined length. The tubing can also stretch as the robot moves, which puts undue stress on the cables. Tooling interference sometimes occurs because there is no control path for movement.

### Enclosed dress pack

An enclosed dress pack mounts directly to the robot and is available in multiple configurations. It uses corrugated tubing installed inside a plastic-reinforced housing to protect cables. The system's spring-loaded design minimises catch and pinch points.

Due to the completely enclosed housing, cable maintenance is difficult and, because it is not modular, the entire unit must be replaced if one component breaks. Problems can also arise if the programming or movements of the robot change. This is because an enclosed dress pack does not prevent the cables from exceeding their maximum bend radius.

### Robotic cable carriers

Robotic cable carrier systems are at the core of the less-is-more approach, and can be used universally for six-axis robots. The system mounts directly to the robot and is available in multiple configurations. Like an enclosed dress pack, it has a spring-loaded design, which minimises catch and pinch points. However, robotic cable carriers offer additional benefits not available with other systems. They can come equipped with strain relief options to extend the service life of the cables, and cables can be quickly added or removed without dismantling the system. The defined bend radius of a robotic cable carrier protects cables from exceeding their maximum bend radius.

The limitations of the system include minimal resistance to high-concentration acids and caustic chemicals, and the inability to handle circular movements with heavy loads.

Robotic cable carriers are well suited to welding robots in tight areas, multiple-tool applications, material handling jobs and de-burring operations. For added flexibility, robotic cable carriers are available in a fully enclosed design, in a pull-through design for easy cable access, or as a lightweight, low-cost system for applications that do not require cables to be completely enclosed.

### Additional tips

Ideally, a robotic cable carrier system should allow sufficient clearance inside the cable carrier for electrical cables, pneumatic hoses and tubing for other media. This compensates for relative forces between cables and hoses. Cable carrier suppliers typically provide this data. For instance, general rules of thumb for robotic cable carriers include:

- Total cable and hose diameters must not exceed 60% of the carrier diameter.
- Leave at least a 10% clearance between any two cables or hoses.
- Cables and hoses need to move freely inside the carrier.

The less-is-more approach also eliminates some safety concerns within a robotics cell. Cables are able to move more freely, but are protected and guided properly so that they will not injure workers.

### The ideal cable management system

Ideally, a robotic cable carrier system should:

- guide cables in one continuous path
- eliminate loose, unmanaged cables
- control the bend radius of cables to avoid pinching
- have the ability to quickly add or remove cables
- be available as a fully enclosed design for extremely harsh environments.

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# AS I SEE IT



## HOW TO AVOID BECOMING A VICTIM OF DIGITAL DARWINISM

I recently had the opportunity to speak at Siemens's Digitalize 2017 in Sydney. One of the key emerging topics at this event was how technologies such as the Internet of Things (IoT), automation and artificial intelligence (AI) are becoming the foundation for how businesses operate as we move forward into Industry 4.0.

We also had some timely reminders of what can occur when companies don't make the change to a digital enterprise efficiently and effectively. In many cases they are not able to survive, and become victims of what we could call 'digital Darwinism'.

Beyond developments in technologies related to the IoT and automation, Siemens is witnessing the rapid adoption within process and hybrid process industries of technology and practices that are already well established within advanced discrete manufacturers and their supply chains, such as those in the automotive and aerospace industries. That is, practices whereby vertical and horizontal integration of every function and hierarchy is connected across the entire value chain of an enterprise through digital collaboration.

Such a digital collaboration chain unifies people, processes, workflows, manufacturing and production assets, automation, simulation-based digital twins and cloud-based applications, the value of which is to bring correctness and agility to decision-making, as well as flexible operations, efficiency, consistent quality, security and (ultimately) greater productivity to manufacturing or processing enterprises.

Gaining control of data and information is an essential part of the digital transformation process. Manufacturers, for example, can apply certain data to change the configuration of a product so it can be adapted within an existing system. The ability to have an offline or online digital twin — to be able to pre-test, pre-commission or monitor performance while things are running — is of considerable value.

There are a few other key aspects of data analysis that are important in a digital enterprise. These are connectivity, flexible operations and standardisation. Data today

must be accessible to people working from different countries and speaking different languages. The whole idea within Industry 4.0 is that the data must be in conformance with common standards, since devices talk the same language and same concepts, even if people don't. It is at the higher levels of analysis, where human decision-making occurs, that the data can be presented in the most efficient way for people to understand, wherever they happen to be.

Once control of information, workflows, asset data, analytics, human feedback and machine learning are all added in, businesses can achieve prescribed or deductive decision-making.

Moving forward with digital transformation, different technologies will be available so that enterprises can maximise what they do with data. Such technologies let businesses connect multiple machines and physical infrastructure to the digital world and provide industrial apps and digital services that can get more productivity and efficiency across a business. These open systems enable businesses to reduce downtime, increase output and use assets more effectively.

For any progressive business, consistency, integration and access to data must be a priority. This will put you in a better position to understand what is happening within your enterprise and enable correct and positive changes, as you need, with little or no effect on manufacturing or production output.

Ultimately, the aim is to ensure you ensure your place in an ever-growing competitive landscape and avoid becoming a victim of digital Darwinism.



*Hakan Ozcelik is the Digital Enterprise Portfolio Development Manager at Siemens, managing the market, industry and business development for key accounts in the Siemens PLM portfolio. His previous roles in engineering have been at Concentric Asia Pacific and LMS International.*



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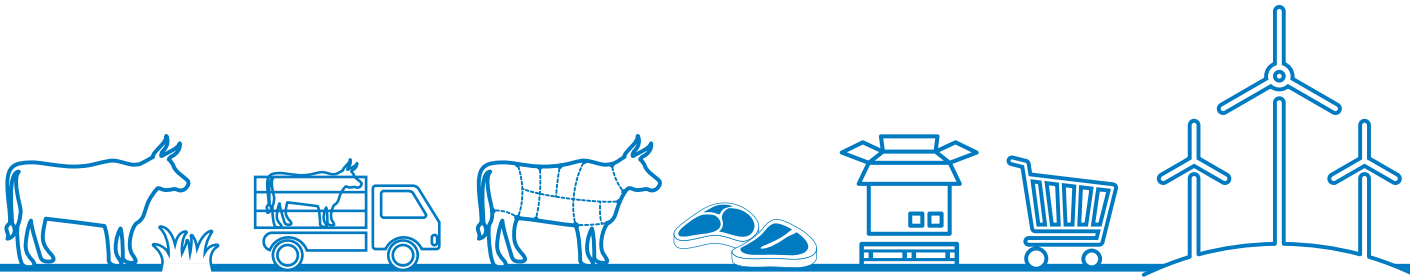
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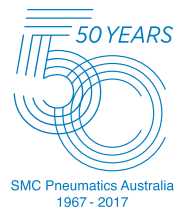
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