Control, Instrumentation and Automation in the Process and Manufacturing Industries

November 2016

CONTROL ENGINEERING EUROPE

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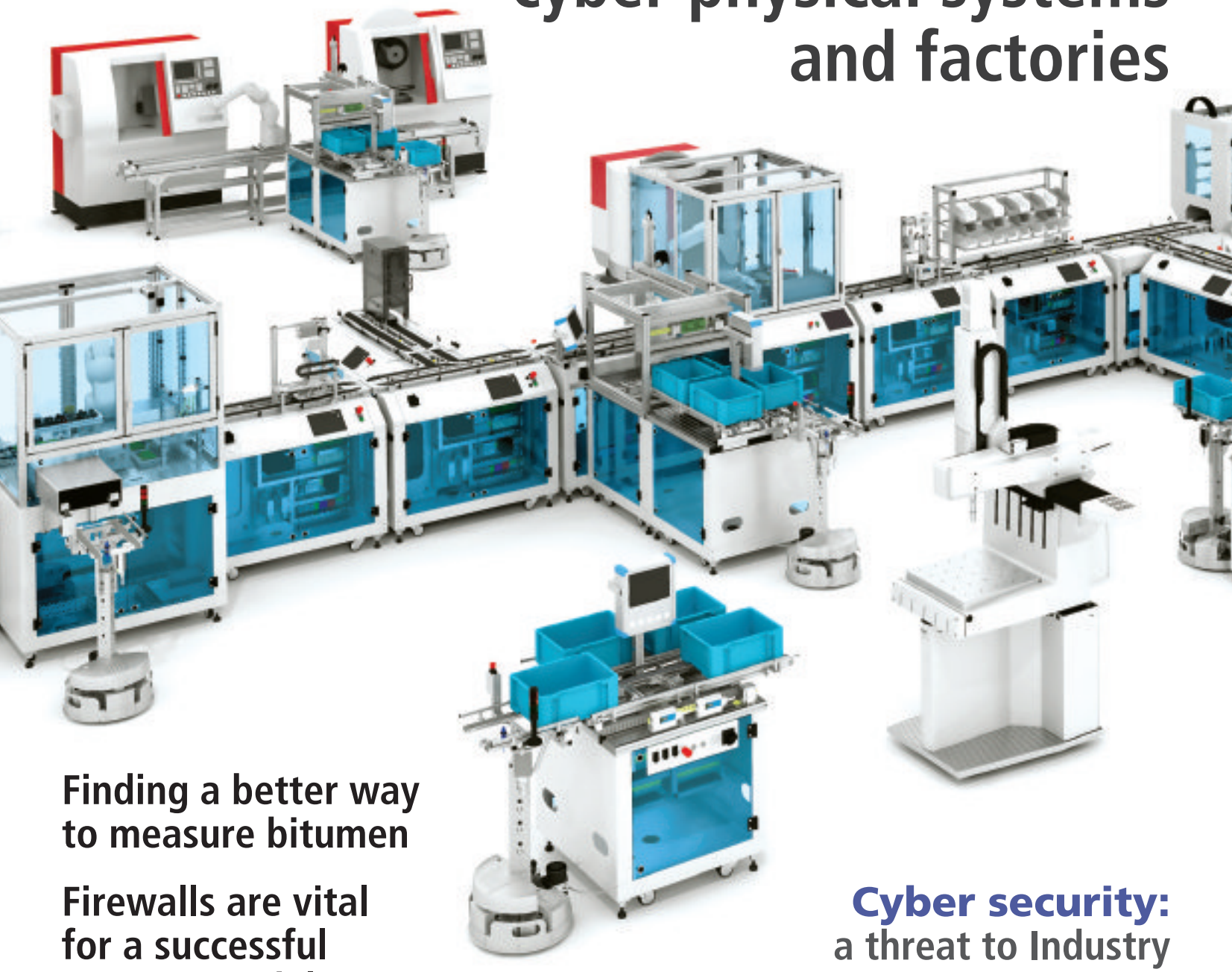
From vision to reality: cyber physical systems and factories



Finding a better way to measure bitumen

Firewalls are vital for a successful security model

Cyber security: a threat to Industry 4.0 implementation?

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Finding solutions to make you more agile…

End users today face many challenges. They need to be more productive and more agile to help keep up with rapidly changing consumer demands. This requires many to consider a completely new production approach to ensure continued competitiveness. Events like the SPS/IPC/Drives show have, therefore, become even more relevant for end users looking for solutions to give them the necessary production agility and in most cases automation is the key. The event will, once again, focus on Industry 4.0 and the components and solutions that are available to help make progress towards smarter factories. Find out more about the event in this issue. (pg 22)

The *Control Engineering Europe* team will be roaming the halls of the Nuremberg Messe during the event this year, gathering information for future issues, so if you have something that you think is worthy of mention please do let us know.

One of the most important requirements for smarter factories is to open up the, traditionally closed, plant networks to the enterprise to allow for a more open exchange of data. This, of course, brings with it greater security risks, which do need to be properly managed to ensure that you are able to make the best use of all the additional data, produced as a result of the Industrial Internet of Things, without falling foul of a cyber attack – whether intentional or accidental. This topic is covered in some depth in this issue. (pg 28)

Suzanne Gill – Editor
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OEM's: are you prepared for PaaS?

Bob Hillier discusses the concept of Products as a Service (PaaS) and the software tools that can help OEMs make the move to this new sales model.

Rolls Royce recently celebrated the 50th anniversary of its 'Power-by-the-hour' approach to engine maintenance management. Since its introduction, companies from the automotive, aerospace and industrial sectors have followed suit, making PaaS plans available to their customers.

Offering PaaS requires a complete transformation of the OEM business model. It returns ownership and responsibility to the OEM, which drives the need for more reliable and higher quality products. If adopted on a wider scale, the PaaS business model becomes the basis of what industry is calling the new circular economy. As opposed to today's economy, which is linear because products are bought, used and then disposed of, in the circular economy, a product is kept in use for as long as possible and is fully recycled at the end of its life.

One of the main advantages of offering PaaS is that it gives OEMs an opportunity to build long-standing relationships with their customers and presents opportunities for the proposal of additional products and services to compliment those already being used.

Research into PaaS suggests that such a business model can lead to increased economic and environmental efficiency, or eco-efficiency – a concept that refers to maximising value, while minimising environmental impact. It drives the OEM to increase product efficiency and quality.

When purchasing PaaS, the customer pays the OEM based on output, rather than input materials. This means the OEM and the customer share the same incentives – lower materials throughput and increased process efficiency, resulting in lower total cost of use to the customer, and greater profits to the OEM.

The Industrial Internet and the Internet of Things bring opportunities for manufacturers to support these new business models in an eco-efficient way. The rise of cloud computing and big data analytics makes it possible for manufacturers to process large amounts of data at a small cost, leading to more in-depth knowledge of the product they are maintaining as part of their service. The challenge is delivering this data in a way that the manufacturer can use effectively; and to give its design and engineering teams concise input to improve the product, its manufacturing, and its in-life service.

So, it is important that OEMs offering PaaS maintain high quality standards throughout the production process with a combination of best practice process quality and product quality. While product quality refers to the end product meeting the required specifications, process quality ensures the manufacturing and testing procedures are well-defined and measured.

Bob Hillier is managing director of product lifecycle management PLM solutions provider, Design Rule.

Remote control of a North Sea platform

Honeywell Process Solutions (HPS) is to provide advanced automation and safety solutions to enable remote onshore operation for an offshore platform in the North Sea, reducing overall production costs and improving safety.

When drilling operations are completed, Statoil's Valemon platform, located on the Norwegian Continental Shelf, will become a periodically-manned installation and Statoil's first platform to be operated from shore. Control operations will be located in Bergen, 160km from the platform itself. This will improve the overall safety of operations while boosting efficiency by centralising the controls.

"This project is a great example of how Honeywell is able to use its technology and experience to help Statoil remotely control operations at an important gas production facility," said Pieter Krynauw, vice president and general manager of the Projects and Automation Solutions business within Honeywell Process Solutions. "As companies move oil platforms farther offshore and into other remote, challenging locations to find oil and gas, managing those operations efficiently, while reducing risk to workers, will become increasingly important."

Honeywell will serve as the engineering, procurement and construction (EPC) automation contractor for the project. The company will provide a range of control and safety technologies for the project, including new operator stations and critical alarm panels at the onshore operations center that will communicate with the systems on the plaform.

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DIN-rail mountable servos with integrated safety

The servo terminals in the Beckhoff EtherCAT Terminal system integrate a complete servo drive to facilitate highly dynamic positioning tasks in a standard I/O terminal housing.

The latest EL72x1-9014 version, STO (Safe Torque Off) safety functionality is now available in an extremely compact terminal design for DIN rail installation. The new servo terminals enable space-saving drive solutions with safety-related functions that can be directly integrated within the EtherCAT Terminal system.

The new servo terminals are said to streamline the implementation of STO safety functions, corresponding to safety level Cat 3/PL d, according to EN ISO 13849-1:2015.

In conjunction with Beckhoff's One Cable Technology (OCT), safety integration in an I/O terminal form factor results in a heightened ability to implement space-saving and cost-effective solutions with safety-related drive functionality. In addition, a 2-channel shut-off with corresponding contactors in the motor cable provides a reduction in cabling, space requirements and cost.

Rugged handheld communicator improves maintenance efficiency

Emerson Automation Solutions has launched the AMS Trex Device Communicator, a handheld communicator designed for use in harsh industrial environments.

With a task-based graphical user interface the Trex communicator is said to make device and loop diagnostics easy to understand and field activities easier to complete.

Protected against moisture and extreme temperatures, the unit is able to withstand the bumps and drops that come from normal use in a plant environment. The large, full-colour touchscreen display adjusts to lighting conditions and aids troubleshooting in areas where too much or too little light makes other devices difficult to read.

With intrinsic safety certifications, the communicator is certified to go anywhere that a technician can go, with no need to shut a process down or get a hot work permit.

Using its built-in Foundation Fieldbus and HART device diagnostic software, technicians are able to isolate and repair problems while the devices continue to run. Segment and loop diagnostic tools allow users to validate loop and fieldbus segment characteristics for easy troubleshooting. With the ValveLink Mobile app, technicians can analyse valve diagnostics results easily on the communicator's larger screen.

Alkylation technology employs ionic liquids

Honeywell UOP has introduced a new alkylation technology to the refining industry. Developed by Chevron U.S.A. Inc., it employs ionic liquids as a catalyst to produce high-octane motor fuels.

Alkylation technologies are commonly used to produce high-octane gasoline blending components to make clean-burning fuels. The majority of alkylation processes use hydrofluoric or sulfuric acid processes.

Chevron has licensed the technology to Honeywell UOP, which will offer the technology under the ISOALKY brand as an alternative to traditional technologies that use hydrofluoric or sulfuric acids as a liquid alkylation catalyst.

"Ionic liquids alkylation offers a compelling economic solution compared to conventional liquid acid technologies while delivering the same yields and high levels of octane," said Mike Millard, vice president and general manager of Honeywell UOP's Process Technology and Equipment business. "This is a revolutionary new technology for refiners to produce alkylate and improve the quality of their gasoline pool."

The technology uses a non-aqueous liquid salt, or ionic liquid, at temperatures below 100°C to convert a typical stream from a fluid catalytic cracker into a high-octane blending component that lowers the environmental impact of motor gasoline. Among the benefits of this technology, the ionic liquids process can be used in new refineries, as well as existing facilities undergoing capital expansion. It can produce alkylate from a wider range of feedstocks using a lower volume of catalyst. This liquid catalyst has a negligible vapour pressure and can be regenerated on-site, giving it a lower environmental footprint than other technologies.

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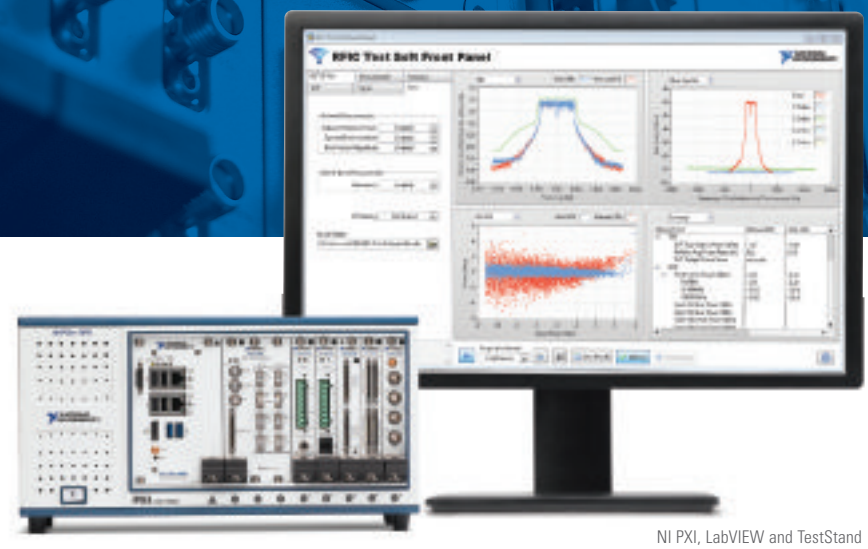

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From vision to reality: cyber physical systems and factories

Festo is at the forefront of Industry 4.0 – from learning to initial applications, from products and solutions to its revolutionary research on BionicANTs – it is helping develop ground-breaking solutions and helping to significantly improve productivity.

A flexible loading module for end of line packaging is controlled by a Festo CODESYS controller CPX-CEC with IP65/67 protection for compact on-site installation – without a control cabinet.

Digitalisation offers increasingly better ways of processing data from production systems in real time and using it to increase plant efficiency and flexibility. However, the rapid rise in the quantity of data and network complexity requires the use of products that make the flow of data easier to plan and manage – both at production level and for the training and development of skilled workers.

It is important to employ components and network technologies that are compatible with the relevant interfaces to ensure the overall result is a stable IT and production system to deliver the promised efficiency increases. Skilled workers must be taught to develop a deep understanding of the structure and programming of digital facility networks for this purpose.

CP Factory and SmartFactory

Festo's CP (Cyber Physical) Factory learning and research platform provides access to the technology and applications of Industry 4.0. The platform demonstrates the future of the production environment in a locally-controlled intelligent network. Some of the principles utilise information gained from the SmartFactoryKL project which is a manufacturer-independent demonstration and research platform designed to prepare the way for the intelligent factory of the future.

Festo was one of the initial SmartFactoryKL partners and has been able to transfer aspects of its research and learning to its own training platform – CP Factory – at Festo Didactic. The company has also utilised its learnings in its own valve production lines which utilise OPC UA as a communication backbone and feature modular machine module designs with decentralised intelligence.

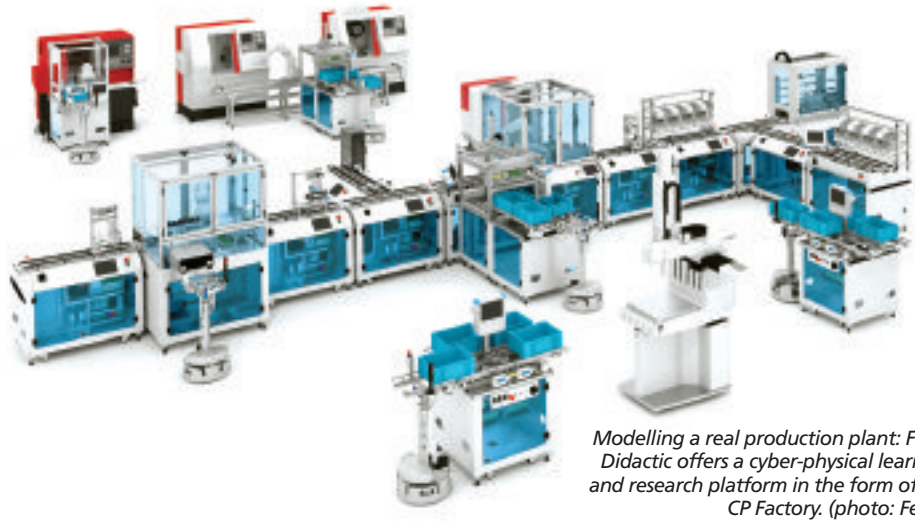
Decentralised intelligence, rapid availability and analysis of relevant data are essential prerequisites for the success of Industry 4.0 – for more individuality and flexibility, as well as greater system availability to enable increased productivity. Cyber-physical systems will form the basis for this future reality.

Modularity, energy efficiency and the use of OPC UA as a communication standard are other features of Industry 4.0, and these are already being implemented by Festo in decentralised automation solutions and mechatronic subsystems which has enabled the company to create, for example, a flexible loading module for end of line packaging, helping to provide answers to key questions about Industry 4.0.

Lean and intelligent

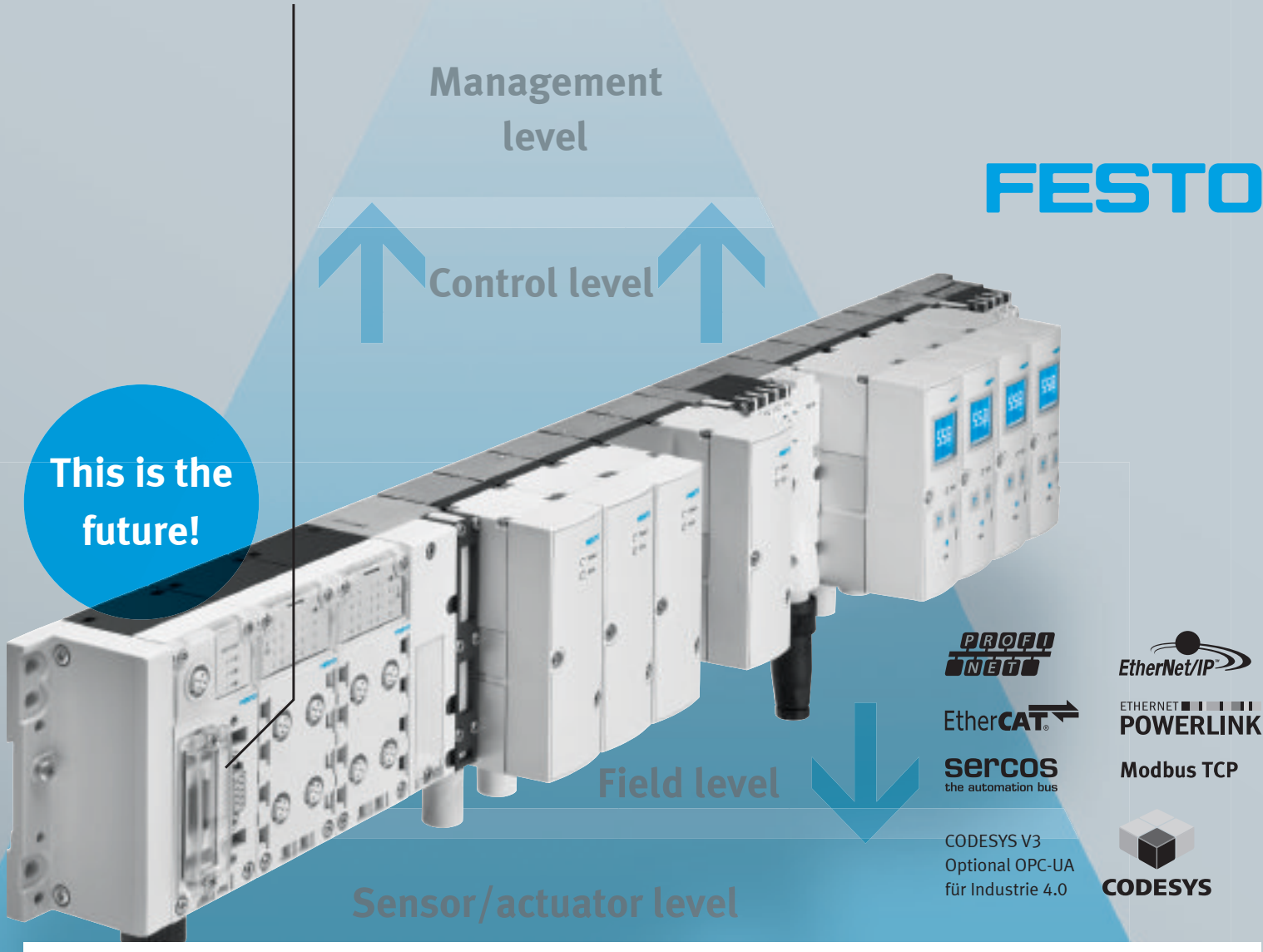
The application is controlled by a Festo CODESYS controller CPX-CEC with IP65/67 protection for compact on-site installation – without a control cabinet, neatly integrated into the system. All fieldbuses or Industrial Ethernet, as well as the Industry 4.0 OPC UA standard, are available as interfaces. Festo can provide users with additional support in the form of reliable services – from engineering and commissioning right up to system operation with software tools, online offerings and advice.

Generating more data is only of value if you can turn this into usable and actionable information. Employees in industry, as well as students at vocational colleges and universities, therefore need to be trained specifically for Industry 4.0. The CP Factory from Festo Didactic enables this.



Modelling a real production plant: Festo Didactic offers a cyber-physical learning and research platform in the form of the CP Factory. (photo: Festo)

New CODESYS Softmotion Controller with OPC-UA, CPX-CEC-M1-V3



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A better way to measure bitumen?

Bitumen is the glue that transforms aggregates into asphalt. It needs to be delivered in accurate doses, which is not possible with traditional mechanical flowmeters. *Carl Pinches* suggests a solution.

Globally, around 120 million tons of asphalt is produced every year.

By weight, 95% of asphalt consists of stone, sand and other fillers. The remaining 5% comprises an agent that binds all of these materials together. This is usually bitumen which is derived from crude oil.

Asphalt is produced by blending the aggregates and then heating them to a temperature suitable for coating with bitumen as binding agent. With the drive toward reducing the amount of energy used in the process, there is increasing adoption of process control and instrumentation. In particular, highly-automated batch and drum-drier plants are becoming more common because they can deliver the consistent quality mixes needed to meet even the most technically complex end user requirements.

The specific gravity (SG) of the bitumen must be a compensatory factor. However, this varies according to both penetration grade and temperature. As a result, to ensure the correct amount of bitumen is added to the aggregate mix to create asphalt, operators must know the grade of the bitumen as well as its temperature at the moment of mixing.

Bitumen needs to be stored at a minimum of 150°C to ensure it remains in a liquid state – below this temperature it will start to solidify.

Temperature compensation is difficult to address. Currently, the most commonly used solution is the use of manual look-up tables. Typically, this is carried out at the start of a batch or even the start of a shift. However, in reality, the temperature is constantly changing. And this is just one of a number of critical factors that can have a dramatic impact on the specific gravity and so can adversely affect the accuracy of flow readings.

Traditional solution

Traditional flow measurement of bitumen is based on a volumetric principle. Mechanical flowmeters are typically used, however these have several disadvantages when deployed in a state-of-the-art asphalt plant. Specifically, these meters are prone to inaccuracy; tend to drift over time; are difficult to integrate into a modern control system; and only measure volumetric flow.

Siemens suggests that mechanical volumetric meters be replaced with with modern mass flowmeters. The Siemens SITRANS FC430 Coriolis digital mass flowmeter, for example, can provide high accuracies (0.1%) and, due to its compact size, can be retrofitted into existing applications. Its sensor construction filters out plant vibration, which can cause measurement inaccuracy.

In addition to improved accuracy and long-term repeatability, the SITRANS FC430 also eliminates the need to compensate for other process variables. No other flowmeter approach can measure mass flow, volumetric flow, density, pressure and temperature – in a single, self-contained, device.

With the Coriolis digital mass flowmeter, operators are able to accurately prepare the bitumen dose based on an actual measured weight rather than an indirectly compensated volume. For example, for 1000 kilograms of aggregate, the operator can simply call for 50 kilograms of bitumen to make a typical mix. All other bitumen variables then become irrelevant. The resulting specific gravity is automatically taken into account even when blending different bitumen grades.

Frequently, a SITRANS FC430 is able to replace an existing flowmeter with minimal pipeline modifications. While there are standard criteria related to pump and bend proximity that must be taken into account, owing to the compact size of the flowmeter these are not a significant issue.

The natural properties of bitumen mean that pipe trace heating and

The SITRANS FC430 Coriolis digital mass flowmeter automatically compensates for changes in specific gravity, temperature and grades of bitumen enabling the perfect asphalt mix to be obtained.

insulation need to be reinstated over the flowmeter so that the bitumen can still freely flow. Remote electronics, mounted away from the primary sensor location, means that system commissioning and maintenance can be handled from a safe area, such as a control room or electrical cabin.

Unique support tools provide direct access to all operational and functional data, certificates and audit trails. The SITRANS FC430 is believed to be the first Coriolis flowmeters to offer hazardous zone and SIL certification options, ensuring high standards of safety and reliability.

Carl Pinches is UK industry manager – minerals and Energy – at Siemens Industry Automation.

Bluetooth radar level sensor for the water sector

The new VEGAPULS WL S 61 contactless radar sensor, from VEGA, offers a level sensing solution for applications in the water and sewage sectors.

Radar technology can offer advantages when compared with ultrasonic level sensors, says the company. Radar is independent of weather influence: strong sun, wind, surface turbulence, condensation, fog or rain. In addition, no compensation is needed for signal transmission time due to air temperature fluctuations.

Radar sensors are ideal for level control and flow measurement in water treatment plants, says Vega. Their focusing capability enables use in sewage pumping stations, rainwater overflow basins, digesters, sludge tanks, open channel flow measurement and for open water level gauging too.

As a compact, loop powered sensor, with an accuracy of +/- 5mm and range up to 8m along with its flexible mounting options, it can be easily installed into new or existing applications. Connection to level controllers, telemetry or SCADA systems is straightforward too.

Cost has, traditionally, been perceived as an issue with radar technology, but the new variant VEGAPULS WL S 61 is more price competitive when compared with short range ultrasonic systems. It has a fully featured specification, performance and design optimised for use in the water-supply and sewage sectors. It complies with the latest Level Probing Radar standard (LPR): approved for open-air use without restrictions or special attachments.

Blue or red laser triangulation sensors?

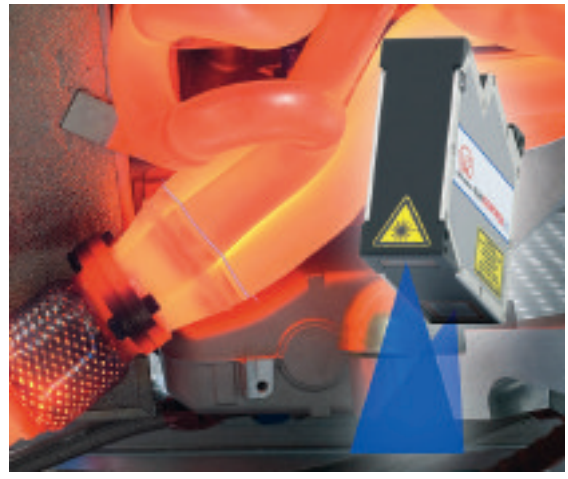
Red laser triangulation displacement sensors have been around for some time, while blue laser versions are a newer addition. Before selecting which to use, it is important to understand which type performs best on which target materials, says *Chris Jones.*

Laser triangulation is one of the most widely known non-contact methods of industrial displacement measurement. Traditionally, this sensor technology uses a red laser light source. Red laser sensors have been in use for over 20 years so are well-proven to provide good measurement stability on a wide range of dynamically changing surfaces, including low reflectivity and matt surfaces, as well as on fast-moving objects. However, on certain materials, red laser sensors perform less well. Before deciding whether it is best to use a blue laser triangulation sensor over a red one a number of factors should first be considered.

Laser triangulation

In the laser triangulation principle, a laser diode projects a visible point of light onto the surface of the object being measured. The back-scattered light reflected from this point is then projected onto a CCD or CMOS array by a high quality optical lens system. If the target changes position with respect to the sensor, the movement of the reflected light is projected onto a different part of the CCD array and analysed to output the exact position of the target. The measurements are processed digitally in the integral controller and then converted into a scaled output via analogue and digital interface RS422, Ethernet or EtherCAT.

The measurement object or target material itself is critical in determining whether a stable measurement can be achieved. Certain objects or materials such as red-hot glowing metals, emit a high proportion of light at the wavelengths in which red lasers operate. This floods the CCD/CMOS detector and therefore stable measurements cannot be achieved. As the target becomes hotter and so emits higher intensity light, the laser measurement fails completely.



However, a blue laser works at a shorter wavelength of 405nm, which is far from the red part of the visible spectrum. This means it is unaffected by the emitted light, which is blocked from entering the detector by using a simple optical filter, ensuring very stable signals. While blue laser sensors were originally developed for the steel processing industry for use on red-hot glowing metals, as well as for automotive brake disc deformation testing and for measuring vibration on exhaust manifolds, other applications for blue laser sensors have since been discovered.

When measuring organic materials, foodstuffs, transparent or translucent materials, due to its shorter wavelength, blue laser light has a lower intensity and so penetrates significantly less into the surface than a red laser. Conventional red laser light penetrates more into the target material and is diffused there, resulting in a de-focused spot on the

When measuring organic materials, foodstuffs, transparent or translucent materials, due to its shorter wavelength, blue laser light has a lower intensity and so penetrates significantly less into the surface than a red laser.

target surface. This results in a blurred spot being reflected back onto the detector, which means the sensor cannot define an exact distance. In contrast, the blue laser light does not penetrate into the target object due to its reduced wavelength and intensity. The blue laser produces a very small focused laser point on the surface, providing stable and precise measurement results.

Polished surfaces

In addition, due to its shorter wavelength, blue laser sensors also perform better on highly polished or gloss surfaces. A red laser light is distorted by the shiny surface, resulting in a 'speckle' effect. This produces increased signal noise on the detector and therefore a loss of measurement accuracy. In contrast, the shorter wavelength of the blue laser sensor performs well with less speckling, resulting in lower noise levels, typically by a factor of two to three compared to red laser sensors.

The advantages of triangulation using a blue laser light not only apply to one-dimensional measurements – distance, displacement, thickness and vibration – but also to multi-dimensional 2D and 3D inspection such as profile or contour measurements. Here, using blue laser sensors rather than red has opened up new measurement applications that were previously not possible. Profile measurement of red-hot glowing metals, organic materials, foodstuffs, transparent and highly polished surfaces are best carried out using a blue laser profile sensor.

It is important to stress that in a high percentage of measurement applications, red laser sensors will be more suitable than blue laser sensors. With its higher intensity, a red laser sensor performs better on lower reflectivity or matt surfaces, particularly on fast-moving targets. In addition, suppliers typically offer more variants and options for red laser sensors in terms of sensor performance, measuring ranges and more cost effective solutions.

When selecting a laser triangulation sensor for a displacement, distance or profile measurement application, it is important to consider the temperature and surface characteristics of the target object. Questions to ask include whether the material or surface will change dynamically as the measurements are taking place? Does the target appearance change from dark to white? How fast is the target object moving and how accurate do the measurements need to be? This will dictate whether a blue or red laser is more suitable for the application.

Chris Jones is managing director at Micro-Epsilon UK.

Fundamentals of measuring humidity

Measuring and controlling water vapour in industrial systems is critical. Temperature and pressure affect materials and systems; water vapour can affect the chemistry.

Physical chemical principles that govern water vapour measurement impact industrial components and systems.

Water vapour is present in the ambient environment and, as such, will permeate into many critical materials and systems of industrial, agricultural, pharmaceutical, and medical importance.

For example, moisture in plastic pellets during processing can cause extrusion failures while non-ideal levels of moisture in foodstuffs can lead to loss of food quality. Moisture in stored drugs can cause loss of activity, and humidity in electronic grade industrial gases may lead to semiconductor component failures. Incorrect levels of humidity in medical gases can lead to improper lung function in the clinical environment. The effects of water mentioned above can be attributed to the following behaviour:

- Water can act as an acid or a base
- Ability to be absorbed into materials can lead to corrosion
- Expansion when it transitions from a liquid to a solid which can damage mechanical components, such as valves, pumps, compressors, as well as the erosion of concrete and masonry structures as shown in Figure 2.

Figure 1: *Oxidised and exposed rebar in reinforced concrete of an overpass structure. High humidity over time will encourage the oxidation process, and concrete erosion ensues. Images courtesy: Edgetech Instruments Inc.*

Figure 2: *The beginnings of the oxidation process in a pylon of an overpass structure.*

For reasons above, measurement and control of water vapour in industrial systems are critical. Concentrations of interest range from 1 part per million by volume (ppmv) or less to 100,000 ppmv, depending on the ambient temperature. The key to understanding the behaviour of water vapour in environments of practical significance is its conformance to Dalton's Law of Partial Pressures and the Ideal Gas Law. Dalton's Law states that the total pressure of a gas mixture is the sum of the partial pressures of the separate gas components.

Online understanding:

Four equations and three sample questions with this article online help with the understanding of water vapour and with related measurements.

Water vapour measurement technologies

Water vapour can be measured using a wide range of technologies. These technologies can be broadly segmented into two classes; those that employ first principle measurements and those that use secondary principles. Examples of the former are chilled mirror hygrometry and spectroscopy, and those of the latter variety use dielectric changes in organic and inorganic media, polymers, and inorganic oxides, respectively.

First principle devices tend to be less subject to drift, while secondary standards are more prone to drift, requiring more frequent calibration. For a sensor to be made traceable, there must be an uninterrupted record of calibrations through the operating life of the sensor.

The table summarises some of the humidity measurement technologies used in the industry.

The concentration of water vapour can vary by as much as 1 million fold from less than 1 ppmv water vapour to greater than 100,000 ppmv.

It is important to understand the physical chemical principles that govern the behavior of water vapour, the key units of measurement, and comprehending humidity principles as they impact industrial components and systems.

Dr. Gerald Schultz is the chief scientist at Edgetech Instruments Inc.

Table: Technologies summarized

Operating principle	Technology	Comments
Spectroscopy	NIR	First principle
	Lyman alpha UV	First principle
	Microwave	First principle
	NMR	First principle
Chilled mirror	Optical	first principle
Psychrometry	Differential temperature	First principle
Electrical	Organic polymer	Secondary principle
	Inorganic porous media, aluminum oxide	Secondary principle
Mechanical	Horse hair	Archaic

MANAGED SWITCHES for critical control networks

Future proofed automation and data communications within the oil and gas sector is pivotal to improving operational efficiency and safety.

Chempark Záluží is the largest chemical production facility in the Czech Republic. Owned by Unipetrol, the facility is currently the seat of many chemical and service companies.

The part of the plant where ethylene is produced is particularly important as it is widely used as a component in many other products produced at the plant. A halt in ethylene production would have enormous economic implications because it would affect overall production at the site. For this reason the ethylene plant has been the subject of a complete new network backbone for power control and distribution as well as an upgraded network backbone for the emergency shutdown system.

The communication infrastructure was built and implemented by Inelsev, a Czech company that provides services for industrial automation. A decision was made to use Westermo switches as part of the design, based on an existing strong working relationship between Inelsev and Westermo's Czech distributor.

"This is a plant where reliability is absolutely crucial. The systems are designed to be extremely robust in order to guarantee continuous operation and to protect the plant and the people," said Pavel Ješina, R&D manager at Inelsev. "In the previous network solution, we used another switch brand that we had to replace. The main reason for that was the network ring recovery time. Whenever the network had to recover, it took so long that connected equipment (OPC servers) would not start up and connect properly. WeOS powered Westermo products, including the ring network protocol FRNT with 20 ms recovery time, was a perfect fit."

Pavel Ješina with a Westermo RedFox switch.

An Inelsev operator overviewing power distribution at the ethylene plant.

An upgrade project

The two networks were built in 2011. The emergency shutdown system was an upgrade project where old switches from another brand were replaced with Westermo Lynx switches in a dual ring network topology. The purpose of this network is to shut down the plant in an emergency situation. The power control and distribution network was built as a completely new system and connects 30 substations throughout the plant with a central control room. The network consists of 270 communication devices, over 500 process screens and panels, 13,000 I/O connections and more than 300,000 alarms.

The many combinations of ports and the ability to mix copper and fibre media was another driver for selecting Westermo products. "Inside a building we can use regular copper Ethernet cables, but the cables connecting the different buildings must be fibre due to safety legislation," explained Ješina.

"The many models and port combinations in the RedFox Industrial range allowed us to select the ideal product at every location and to prepare for expanding the network in the future."

Another positive outcome from using these devices is that configuration and maintenance is simple. All managed Westermo devices are powered by the same operating system, WeOS. This gives an identical experience whether configuring a Lynx, RedFox or other managed Westermo device. It also means that any new functionality added to any new WeOS version will be backwards compatible and available in any previously installed WeOS device. The operating system is designed to be as robust as the hardware. It is made to be simple to use and configure and thoroughly tested in the Westermo software test lab. "I have worked with many different brands of switches and routers, and compared to many others, configuring a Westermo switch is like kindergarten," said Ješina.

Westermo also provides WeConfig, a 'Made Easy' network configuration management tool designed to simplify initial configuration and network commissioning. "I use WeConfig for upgrading the devices when a new firmware upgrade is made available. The tool makes upgrades simple and hassle free and I can access all units from one central point and automated updates are performed swiftly and securely. I am excited to start experimenting more with WeConfig when we expand our network," concluded Ješina.

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Safely keeping pace with the wireless evolution

As the trend towards wireless safety continues, *Neil Dyson* highlights the need to ensure that wireless controls are 100% reliable.

There is a growing trend for wireless modules to be added into everyday products, beyond the more traditional market of laptops and mobile phones. So it comes as no surprise that the machinery industry is following suit as wireless connectivity becomes the expected norm.

One such area is wireless safety-related control systems. As the technology improves this type of system will grow in popularity, given the benefits of faster response times and a more flexible installed base. Wireless safety foot controls, for example, are now available and offer distinct advantages as they are flexible to position and easy to mount – wherever the operator can monitor the process most easily.

While wireless technology affords flexibility in terms of how equipment can be deployed across a site, it does have limitations, which is a concern for safety systems that require 100% reliability.

One such limitation is the sensing range between receiver and transmitter, the strength of which will depend on the local conditions. The radio signal can be strongly affected by conductive materials, as well as other sources of radio interference, and can sometimes lead to a dead spot for wireless connectivity. This can be caused by metal parts, such as wall armour, insulation and metal foils, which are known to reduce the penetration of radio waves to less than 10%.

So, how can machinery manufacturers ensure the reliability of their wireless safety controls and how can machinery end-users be assured of their own personal safety while operating equipment?

Radio regulations

The Radio Equipment Directive 2014/53/EC (RED) was published in the Official Journal of the European Union on 22nd May 2014. As of June this year, it superseded the Radio and Telecommunications Terminal Equipment Directive 1999/5/EC (R&TTE), which was originally published in 1999. Until June 2017, manufacturers have the option of using the R&TTE Directive or the RED. However, from June 2017, the RED is mandatory, and economic operators (manufacturer, importer, distributor, authorised representative), that import, market or sell radio equipment and devices in the EU must comply with the RED.

This means that, having become familiar with the implementation of the R&TTE compliance standards over the last seven years, manufacturers of radio equipment, such as machinery wireless safety functions, now face a new set of requirements. Indeed, the new RED requires a shift in mind-set, as it introduces clearer obligations for all economic operators. Both the requirements and the number of products that fall under the RED have changed, so many economic operators are finding it to be a significant challenge to achieve compliance.

Products which fit within the following definition are subject to the RED: 'Radio equipment – an electrical or electronic product which intentionally emits and/or receives radio waves for the purpose of radio communication and/or radiodetermination, or an electrical or electronic product which must be completed with an accessory (such as an antenna) so as to intentionally emit and/or receive radio waves for the purpose of radio communication and/or radiodetermination.'

Don't cut corners

In order to reduce both costs and time to market for new equipment many machinery manufacturers will rely on the use of wireless modules that already meet some or all of the RED's essential requirements. However, once these modules are integrated into another product, the regulatory requirements will change as the host machine falls within the scope of the RED. Under the RED, the manufacturer must also take into account reasonably foreseeable conditions – use of the product outside of its intended use, for example.

Manufacturers must also document risk analysis and assessment to determine their compliance strategy and the measures taken to reduce the compliance risks.

The most common method of demonstrating compliance with the RED essential requirements would be by using 'Harmonised Standards'. These are written and published under an EU mandate, and provide a 'presumption of conformity' (or compliance), provided they are applied in full. Harmonised Standards are always evolving, so it is important to keep up to date if they are to continue placing products on the EU market.

While a wireless module can be compliant with the RED, if it is then fully integrated into a machine, which is normally outside the scope of the RED, then the machine would fall within its scope and the machinery manufacturer would need to draw up Declaration of Conformity (DoC) accordingly.

The RED's wide-ranging changes demand some significant adaptations as to how radio equipment is manufactured and supplied, and therefore it has major implications for machinery manufacturers integrating wireless safety functions. It is essential then, that those in the supply chain understand their specific obligations so that their equipment complies and can continue to be sold on the European market.

The manufacturer of the final product is responsible for overall compliance and must take responsibility for the wireless module compliance, as well as for the final host product. Ideally, the manufacturer of the wireless module should provide clear instructions to the machinery manufacturer about the correct integration of the module, including details of how to comply with the wireless regulations.

As we see an increasing move from wired to wireless safety functions, it is vital that they are capable of taking the necessary actions to terminate a hazardous event and achieve a safe state to keep operators from harm. The market surveillance authorities can come down hard on manufacturers that supply non-compliant equipment to the market, while machinery end users must also ensure that their machine manufacturer is aware of these new requirements, and that they only employ fully complaint wireless-enabled equipment.

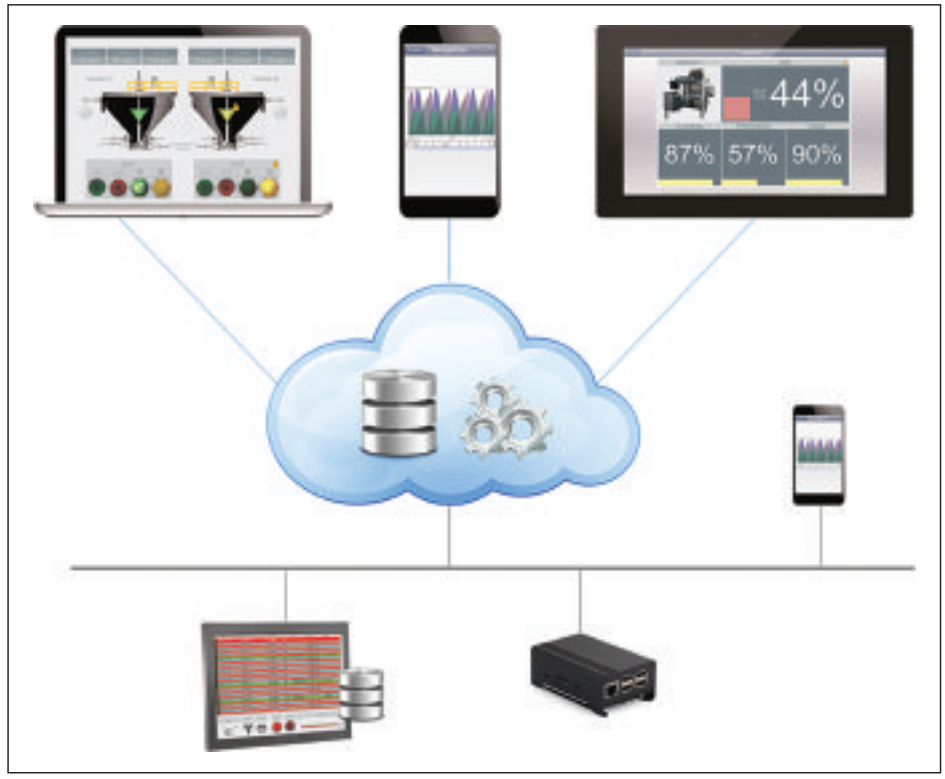
Neil Dyson is business line manager for Machinery Safety at TÜV SÜD Product Service, a global product testing and certification organisation.

Harvesting, storing, and accessing industrial data

Human-machine interfaces (HMIs) can concentrate data and work with the cloud to provide a powerful, scalable, and low-cost means to collect and distribute industrial facility data.

Big Data analysis is among the enabling tools of the Industrial Internet of Things (IIoT) and Industry 4.0. The data starts on the plant floor or other industrial facility as a discrete point, analog value, smart device status, a barcode scanned lot number, etc. This information must then be collected from these edge devices as a first step to Big Data storage and analysis.

Human-machine interface (HMI) data concentrators, connected to controllers, are designed to bring this information together for local use by operators. HMI data concentrators are designed to work with controllers to collect all the edge data for immediate use and process improvements. Some of this information often needs to be stored, usually to analyse the data to improve operations. The cloud provides long-term information storage by working with the data concentrators. Pushing data or even the HMI application to the cloud provides the means to keep machines and processes efficient and available through data analysis.



Hybrid system *integrates a local embedded HMI and cloud-based software as a service (SaaS). Cost is low because the embedded platform doesn't require much computing resources and data storage. Courtesy: Indusoft*

Hybrid system

As the cost for computers and other embedded controllers continues to go down, the use of embedded HMIs connected to the cloud will continue to increase. These embedded HMI data concentrators will continue to shrink in size and price without data storage functionality transferred to the cloud. This hybrid system, with local embedded HMIs connected to the cloud, will provide the lowest cost solution in many cases.

HMI software plays a large part in enabling these hybrid systems. Cloud storage is inexpensive and now HMI hardware and runtime software also are cost-effective. These embedded HMIs can have a very small footprint when used in this type of hybrid configuration, with only 3 MB of memory needed to host the HMI runtime application.

An embedded HMI can be used as a data concentrator in hybrid systems and collect the data before moving it to the cloud.

In some applications, the embedded HMI can be a blind, headless device without a local display. In this case, all the operator interface functions can be performed locally by connecting smart devices such as smartphones or tablets to the cloud. Not only do these hybrid systems provide HMI data concentrator functionality and operator interface, they also have the ability to serve real-time and historical information to remote devices.

Even though most data can move to the cloud, the need for local manipulation and monitoring won't go away and neither will the need to provide information to those who need it in management, or anywhere else in the manufacturing chain.

With the data pushed to the cloud for long-term storage, process improvement becomes viable once enough data has been generated, sifted, and viewed in ERP systems, maintenance systems, dashboards, or statistical analysis software.

Fabio Terezinho, Indusoft director of software development at Wonderware by Schneider Electric.

Technical strategy from IChemE sets out future of chemical engineering

Chemical engineers can help address the most pressing issues for society and the environment. A new technical strategy document – Chemical Engineering Matters – reviews the four key areas of water, energy, food, and wellbeing. Focusing on sustainability and how chemical engineers can make a positive impact, the report also explores external factors such as politics, public influence and the economy.

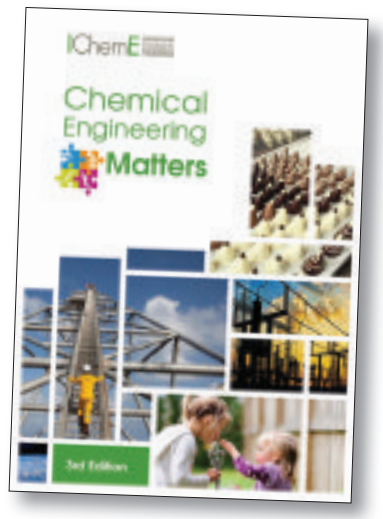
The water vista sets out how process engineering can maximise the value of waste, particularly 'sludge' or sewage, as a material to use as energy.

Efficiency is a top priority in the area of energy, and IChemE's Energy Centre is already working to grow the technical community and increase influence on policy-makers and help them make well-informed decisions. The report outlines the increasing impact on the environment from fossil fuels, and how technologies such as Carbon Capture and Storage (CCS) will be essential in achieving climate change targets.

The latest edition also looks at resources and manufacturing, with an emphasis on the increase in raw material demand and the need to design more efficient processes that use less energy for extraction.

The document, launched at Chemeca 2016 in Adelaide, Australia, will steer the Institution's strategy as it approaches its centenary in 2022.

Chemical Engineering Matters is free to download from: www.icheme.org/cem.



Successful reshoring of injection moulding process

Suscom Industries, a supplier of components to the office furniture industry, stopped all UK manufacturing over 20 years ago, electing to offshore. Today, the company is once again producing its own injection moulded bases for office chairs to a higher quality level, to its own improved design, more profitably and with greater control over stock and availability here in the UK.

The reshoring move followed investment in two 600 tonne Romi presses with product handling and assembly of castors managed by three Kawasaki robots. Autonomy from what is effectively generic designs offered by the Chinese, has allowed Suscom to develop its own high quality chair base range.

Kawasaki Robotics' systems integrator, Evershed Robotics was tasked with the design and installation of the complete cell which was designed around the new tool designs. Cell control is managed through the Kawasaki robots' integrated K-Logic PLCs with each mould tool having its own control box to select the correct programme.

Each press is served by a RS-20N robot which picks the completed moulding and sprue from the mould ejector pins. The new tooling design allows for the sprue to be detached by the tool but to be retained for collection along with the chair base moulding. The robot delivers the sprue to a granulator for recycling and a check to ensure that the sprue is detached from the moulding.

Placing the chair base onto a cooling conveyor the same robot then picks up a slip ring, delivered by bowl feeder, which it assembles into the centre of the moulding. Each press has its own robot and conveyor delivering mouldings to a single RS-50N robot.

This third robot unloads chair bases from the cooling conveyors and places them firstly into a turnover jig and then into a castor assembly cell. Castors can be one of two sizes so the programme ensures the robot is instructed to pick from the correct bowl feeder. After moving to a check point that confirms the correct size has been picked the robot then presses the castor into one of the five location points.

On completion of castor assembly the robot picks up the assembled base and places it onto another conveyor where it is finally unloaded manually.

Joel Rockwood, Suscom Industries production manager, believes that developing a new chair base, designed for automation, has given Suscom a far better product than the currently available generic designs. "Unlike generic imports, mouldings that come straight from our new tooling require no further coatings or fillers, there are no surface imperfections, and they are overall a much stronger product.

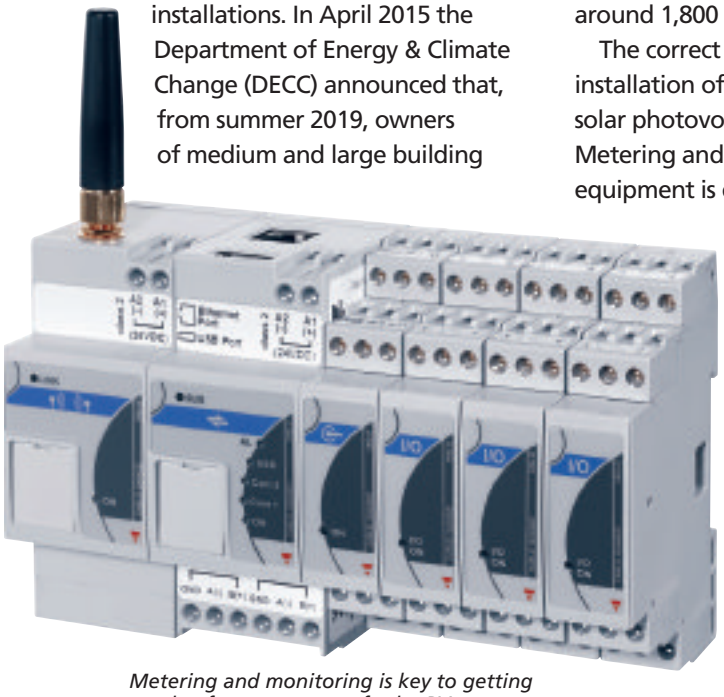
The system has had a significant impact on Suscom's customer service continued Rockwood. "We could see prices rising in China so creating our own in-house design made sense; the payoff for customers is clear as we have maintained, and even lowered, prices together with adding value such as assembling castors and delivering an all-round better product."

Calculating the performance of solar PVs

As the solar PV market expands, potential users and investors are looking closely at array technologies. However, it is equally important to consider good quality metering and monitoring which are a key part of the whole system.

Solar photovoltaics (PVs) continue to be a fast-growing market. Today, financial backers, engineers and building owners are seeing solar PV as a good investment and also as a way of protecting their own costs as energy prices continue to rise as well as offering CO_2 emission reductions.

The UK Government continues to support this technology to assist the UK in lowering its carbon emissions, but it is crucial to continue to focus on removing barriers to PV installation. For example, the fact that the equipment might have to be left behind after an office move, was regarded as a big hurdle to further take-up of commercial PV installations. In April 2015 the Department of Energy & Climate Change (DECC) announced that, from summer 2019, owners of medium and large building mounted PV systems will be able to take their installations with them if they choose to relocate.



Metering and monitoring is key to getting value for money out of solar PV systems.

DECC estimates that the UK has around 250,000 hectares of south-facing commercial rooftops, so it is likely that the use of PV will to continue growing. Industrial and commercial solar installations have seen a boost in applications in the past year and are in line to catch up with the domestic PV market.

Carlo Gavazzi's experience of this market bears out these growth indicators. Between 2009 and 2014, the company has been involved with over 2,000 MW of installed solar power around the world, which amounts to around 1,800 running installations.

The correct specification and installation of technology such as solar photovoltaics (PVs) is important. Metering and monitoring this equipment is equally vital to good long-term performance and ensures that optimum benefits are achieved. Renewable technologies are an investment, and a good metering strategy is vital to both enhance and measure the return on that investment.

If a solar installation is not correctly monitored, a fault can result in significant financial losses. It is possible to lose 20% efficiency, and without a good metering strategy this may not be spotted until a drop-off in power output is detected. For solar PVs, therefore, metering and monitoring is vital to provide clear and concise indication of system performance which will ensure revenue optimisation.

The collection and use of data is also central to the function of good controls, to ensure that a PV system is operating as efficiently as possible. The management and control system for photovoltaic plants has to operate at a number of levels. Firstly, it must measure aspects of the system such as AC and DC monitoring; it must also offer environmental sensing as well as alarm logging.

Good controls

Good controls will ensure that the engineers or designated recipients are sent email or sms messages making them aware of any alarms, such as the PV has stopped working or has been compromised. Performance can be lost if the inverter fails or if they are not correctly connected, dust or dirt can accumulate on the surface, reducing the output or even panels being stolen. The latest controls can also help identify the exact location of a fault, which reduces servicing time and missed yields.

The controls should focus on gathering and communicating useful information to the operators. This includes local and remote databases of historical data as well as analysis functions. The latest controls can deliver the information via the web to a location that suits the users. This could be an energy management company or an in-house facilities team (or both).

Given the importance of delivering data on installation performance, users should also look for controls that offer TCP/IP communication capability. This means that data can be sent exactly where the client needs it. It is important to look for features such as SMS or email notifications of plant failure – given that downtime for a solar installation means lost revenue as well as the costs of repair.

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How to choose the right level instrument for applications

There are many level measuring techniques, however they need to be the right fit for the application. See the three key constraints to measuring solids in tanks and vessels.

Companies dealing with bulk solid materials have to measure the contents in vessels and tanks, as do users working with liquids. However, certain obvious differences make the task far more difficult when trying to get an accurate volumetric or mass measurement of solid products. The biggest difference is the way in which solids flow, or don't flow, contrasted with liquids.

Some solids have sufficient granularity to separate into particles. With these, some may agglomerate into chunks, but the underlying assumption is the material can be poured, at least for the most part. (If a vessel is filled with completely solid material, there are bigger problems than simply trying to measure the volume or level.)

Finding a solid level

Liquids, even those with high viscosity, ultimately come to a uniform level in a container. Solids, on the other hand, form piles. If a pipe or chute is sending granules into a vessel, the highest point will be directly under the pipe. The difference between the highest and lowest point in the vessel may be great, or it may be quite uniform, depending on the material and other factors.

This pile-forming characteristic is quantified as the angle of repose, meaning how steep the sides of the pile can become before part of the pile will slide down. Spherical plastic pellets will not pile up very high because they roll down the sides of their own hill. Other products, even if they aren't sticky, can form higher piles due to the particle shape or natural cohesiveness. Under most circumstances, few products have an angle of repose below 30 deg or above 45 deg. Even wet sand, if allowed to move freely, will not pile up steeper than 45 deg.

Picture a round vessel with a conical bottom as shown in Figure 1. It is filled from a pipe mounted from the roof equidistant from the center and outer wall. The outlet at the bottom is centered, and the cone walls are sloped at 45 deg. When the vessel is being filled, the product will pile up under the inlet pipe and move toward the outside. When the filling stops, there will be a conical pile with the sides approximating the angle of repose for the material. The lowest point in the vessel will be near the walls, farthest from the inlet pipe. When the outlet is opened, the material directly over the opening will fall out eventually creating a hole as the material higher up moves in from the sides and above to fill the void.

Three solid measuring technologies

Techniques for measuring solids are usually from the top to the bottom, with the level instrument mounted on the vessel's roof pointed down at the material. Three types are guided-wave radar with a probe to direct pulse travel, noncontacting radar, and acoustic.

Each has its own peculiarities related to how it handles the characteristics of solids. Under normal circumstances, all three calculate measurements based on the elapsed time between an energy pulse being sent down and a reflection from a point on the surface returning to the instrument.

Figure 1: This hypothetical vessel has representations of all three measuring technologies: guided-wave radar, noncontact radar, and acoustic. All graphics courtesy: Emerson Process Management

With guided-wave radar, it is a very small point, only 1in or 2in diameter surrounding the instrument's probe. The instrument can't create a picture of the whole surface from just one point, but

for some applications, one point may be enough to receive the information. Noncontacting radar and acoustic level instruments can read a larger area, particularly the latter, but may still yield an incomplete picture. Whether it is sufficient or not depends on the needs of the process.

Understanding instrument constraints

Guided-wave radar instruments, as shown on the left of Figure 1, use a probe designed to extend down into the material. The reading signal travels down the probe, hits the surface of the material, and returns up the probe to provide a very precise reading of the material height around the probe. Because the signal travels down the probe, it can have advantages over noncontacting radar in low dielectric applications.

Some probes are made from flexible cable while others are rigid rods. Flexible probes are better for solids because when large amounts of material start moving, the forces can bend or even break a rigid probe due to the unevenness of movement, particularly when the vessel is filling or emptying.

Pull force is a characteristic generated because a probe embedded deeply into a large volume of material can have an enormous amount of tensile force applied as the material moves while the vessel is being filled or emptied. Probes can be yanked out of the instrument housing, or worse, a well-reinforced probe can simply pull the top of the vessel down. But the tensile force can be calculated to avoid these situations. Depending on the material, frequent movement close to the probe can also cause abrasion and premature wear. Still, in the right application, a guided-wave radar instrument can be a very accurate and economical choice.

Dielectrics and bulk density

Noncontacting radar and acoustic instruments depend on sending pulses through open air to the surface of the material and the timing of the reflections (see Figure 2). The accuracy of the measurement depends on the strength and repeatability of the return signal. The characteristics able to create a strong signal make for major differences between radar and acoustic methods. Radar instruments depend primarily on the dielectric constant (DC) of the material, while acoustic instruments depend on bulk density.

With a noncontacting radar instrument, a pulse of electromagnetic energy is emitted. When the pulse encounters a boundary where there is a change in the DC, some of the energy is reflected back. The boundary in this case is the interface between the air in the vessel and the surface of the material in the vessel, which can be solid or liquid. The higher the DC of the material, the stronger the reflection is.

The surface angle presents a problem with measuring the level of solids. If it is flat, the reflection goes straight back to the instrument, but if the pulse hits a slope, part of it can be reflected to the side of the vessel and not captured. In most situations, enough of the signal is returned to get a usable measurement, but if the material has a low DC and a high angle of repose, it makes for a difficult combination. Special solids algorithms in the instruments and parabolic antennas can help with measurements in solids applications.

Acoustic instruments have a similar, but different constraint. An acoustic pulse or sound wave produced by the instrument passes through the air space until it encounters the surface of the solid contents of a vessel or the vessel walls. Reflection strength is determined by the bulk density of the material, which is the mass of the substance in a given volume. So if the material surface stays fluffy, it absorbs some of the sound energy, and the reflected waves are not as strong.

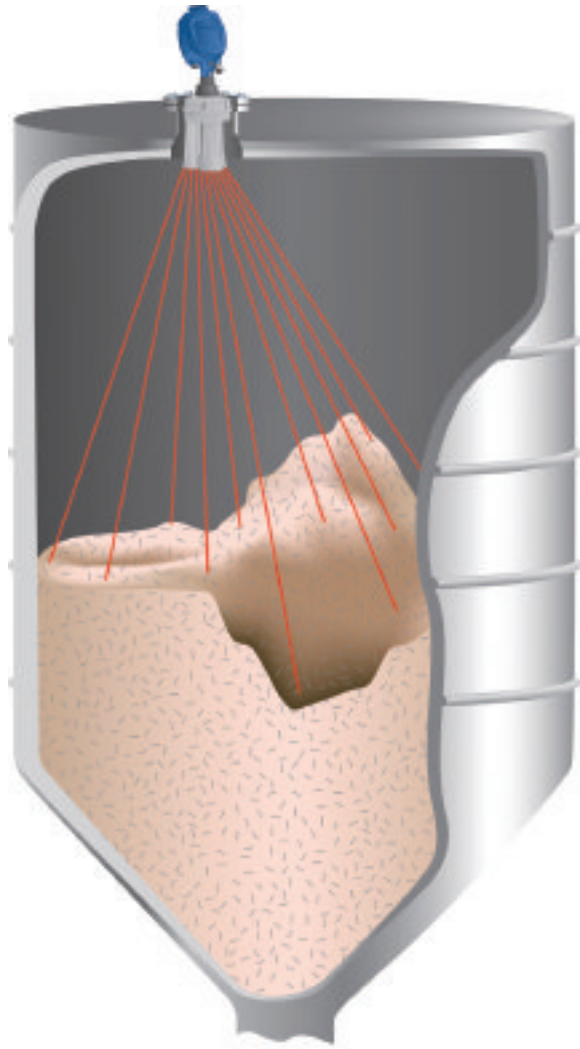


Figure 2: Guided-wave radar and acoustic instruments can cover a relatively large area, but the precision of a measurement depends on distance.

Again, situations where this becomes a serious issue are rare, but it is something to keep in mind with some particularly troublesome products. Since the beam is much wider than noncontact radar instruments, the instrument can capture information for average level calculations over the entire surface it sees.

On some vessels, the level information can be enough to calculate the volume within 3% accuracy, although larger vessels may need multiple devices to get these results.

Lydia Miller is the senior marketing engineer working in the Rosemount Process Level group at Emerson Process Management.

Industrial considerations for PT 100 SENSORS

To achieve the best accuracy and reliability, care is needed with installation of the probe, connections, and choice of the host instrumentation when using Pt100 sensors in industrial applications, says Labfacility.

Unlike thermocouples, the use of a platinum resistance thermometer probe in industrial and scientific applications will normally result in good, accurate temperature sensing without the need for special cables.

The resistance element is produced in one of two forms – either wire-wound or flat film. Metal film resistors consist of a platinum layer on a ceramic substrate; the coil of a wire wound version is fused into ceramic or glass.

Wire-wound resistors

Various methods of detector construction are employed to meet the requirements of differing applications. The unsupported 'bird cage' construction is used for temperature standards, and the partially supported construction is used where a compromise is acceptable between primary standards and use in industrial applications. Other constructional methods include the totally supported construction which can normally withstand vibration levels to 100g, and the coated wire construction, where the wire is covered with an insulating medium such as varnish. The maximum operating range of the latter method is limited by the wire coating to around 250°C.

Flat film resistors

Flat film Pt resistors take the form of a thin (1 micron) film of platinum on a ceramic substrate. The film is laser trimmed to have a precise Ro value and then encapsulated in glass for protection.

A wide range of styles and dimensions are produced to allow for different applications. Such sensors have fast thermal response and their small thermal mass minimises intrusion in the media being tested. Such sensors are known variously as

Controllers for aircraft static and fatigue tests

The Industrial Group of Moog has delivered aerospace test controller systems for use in the Gulfstream Aerospace Corporation's Structural Test Lab to run static and fatigue tests on its G500 and G600 business aircraft.

The control systems include software and controller hardware for applying and analysing wear and tear on an aircraft's wings, fuselage, empennage and components such as flaps, elevators, and horizontal stabilisers. In the span of several years, Gulfstream can simulate the lifetime of the components while keeping the test specimen safe.

Gulfstream has purchased several 500-channel aerospace test controllers from Moog which can be configured into multiple systems, for performing and analysing aircraft certification tests.

During static testing, Gulfstream is using the test controller to apply 150% of the aircraft's limit loads to meet a variety of FAA requirements. The fatigue tests put the aircraft's design life on the test specimen before the aircraft enters service.

"Our control loops make for more efficient testing," said Jeff Townley, Moog senior application engineer. "After two or three years of testing a test specimen will have one or two lifetimes on it. In several years, we can help a lab simulate 20 years of flying, and they know how well a design will hold up."

The design of the controller is expandable to 500 channels.

flat film, thin film or chip sensors.

Fundamentally, every sensing resistor is a two wire device. When terminating the resistor with extension wires during probe construction, a decision must be made as to whether a 2, 3 or 4 wire arrangement is required for measurement purposes.

In the sensing resistor, the electrical resistance varies with temperature. Temperature is measured indirectly by reading the voltage drop across the sensing resistor in the presence of a constant current flowing through it using Ohm's Law: V = R.I.

The connection between the thermometer assembly and the instrumentation is made with standard electrical cable with copper conductors in 2, 3 or 4 core construction. The cabling introduces electrical resistance which is placed in series with the resistance thermometer. The two resistances are therefore cumulative and could be interpreted as an increased temperature if the lead resistance is not allowed for. The longer and/or the smaller the diameter of the cable, the greater the lead resistance will be and the measurement errors could be appreciable. In the case of a 2 wire connection, little can be done about this problem and some measurement error will result according to the cabling and input circuit arrangement.

For this reason, a 2 wire arrangement is not recommended. If it is essential to use only 2 wires, ensure that the largest possible diameter of conductors is specified and that the length of cable is minimised to keep cable resistance to as low a value as possible.

The use of 3 wires, when dictated either by probe construction or by the input termination of the measuring instrument, will allow for a good level of lead resistance compensation. However the compensation technique is based on the assumption that the resistance of all three leads is identical and that they all reside at the same ambient temperature; this is not always the case.

The wiring configuration (2, 3 or 4 wire) of the thermometer does need to be compatible with the input to the associated instrument.

Assuming a 3 or 4 wire connection, and the use of a class B sensing resistor, a standard thermometer assembly will provide an accuracy of around 0.5°C between 0°C and 100°C. Considerable improvement on this figure can be achieved by various means including the use of closer tolerance sensors. It is important to always consider that the overall accuracy of any measuring system – sensor, instrument, interconnection, application will be compromised by the sum of the uncertainties in that system.

Test bench design tips

HBM looks at the critical variables in the design of new test benches and explains how to cost-effectively optimise test routines and shorten test times.

With today's focus on engine development, rolling resistance and energy conversion efficiency, test bench design is critical to bolstering energy and cutting carbon emissions, as this will reduce costs and support manufacturing innovation.

So, when it comes to designing the test bench, what steps can be taken? Firstly, it must be possible to implement test structures quickly. This can be achieved with intelligent sensors and measuring amplifier systems that communicate with each other and exchange data configuration, for example by using Transducer Electronic Data Sheet (TEDS) sensor data detection which offers a standardised method of storing transducer identification, calibration, correction data, and manufacturer-related information.

In addition, the measuring amplifier and control system must be capable of further processing the measurement data in real time so that the test bench can be regulated. It is also essential to capture measurement data at a high resolution for analysis and to be able to save it.

Designing torque sensors

When it comes to design, modern torque transducers must work with digitalised data and at high sampling rates, in order to meet the requirements of the function tests. Ideally, available output signals should include not only torque, but also rotational speed and angle of rotation, as these measurements are important to calculating power and energy conversion efficiency.

As measurements are often taken under harsh ambient conditions, it should also be possible to convert signals into frequency signals, to ensure noise-free transmission.

When it comes to optimising torque data, a measuring amplifier system must include a series of internal computing channels which are specifically designed for operation and use of torque transducers.

This should include a 21-point linearization of the characteristic curve of the transducer, which will improve the raw signal and enable it to be further processed to increase the measurement quality of the test bench.

Other ways of scaling is the use of polynomials and straight pitches. The use of polynomials scaling can increase efficiency as they represent the sensor characteristic with greater accuracy.

To increase the accessible accuracy of torque sensors, calibration equipment can also be used to capture the behaviour of the sensor under various loads, which include dynamic right and left rotation, as well as highly accurate measurement in partial ranges, which is necessary to capture the residual breaking torque, in which different applications are measured during the calibration of the sensor.

Parallel to this, another important function to consider is independent processing of raw measurement value – such as filtering – which makes it possible to adapt the signals for regulation and automation of the test bench.

Due to the work cycle with compression and expansion in the individual cylinders and the corresponding fluctuations in combustion, the torque generated by an engine exhibits highly dynamic

The PMX measuring amplifier, from HBM, is capable of further processing of measurement data in real time to enable test bench regulation. It can also capture and save measurement data at a high resolution for further analysis.

behaviour and, in many measurement systems often appears as 'noise'. In order to eliminate this, a Centre for Advanced Studies in Measurement and Assessment (CASMA) filter angle – synchronously can be used.

Additional functions to bear in mind include the ability to determine peak values or mean values of measurement signals to verify and document test limits. These control values can then be monitored in turn with limit values or tolerance bands in real time, making it possible to control the test bench.

It is also worth noting that if the raw values of the torque measurement with torque and speed are available, they can be used to calculate and output the application of torque in real time, using mathematical computing channels.

Finally, test signals make it possible to test signals and system states, as well as functionality capability during start up, without even having to place the test bench completely in operation. Simply done on the sensor side, by activating a simulated sensor called a shunt signal, this enables the torque transducer to emit 50% of its nominal (rated) signal, enabling the function to be tested in a dry run.

When it comes to performance features of a data acquisition and automation system, the range of measurement signals to acquire is extensive and runs from simple signals acquired at a low frequency, to complex measurement data which has to be simultaneously measured at a high measurement frequency. Decisive factors here include not only durable and accurate sensors, but also robust and accurate measurement acquisition.

Both should be in the same accuracy class and should be at least 0.1%, or better still 0.01%. The sampling rate of the signals is as important as measurement accuracy. It should be high enough so that fast or small partial changes can still be reliably resolved and displayed. In order to cover acquisition of peak values, computing speed and regulating quality, all measuring and computing channels must be sampled in parallel at a rate of at least 20 kHz, which is equivalent to a measurement and calculating grid of 50 microseconds.

PC-based –v- embedded

There is a basic distinction between PC-based data acquisition systems and embedded control systems within the measurement system. This applies to acquisition of measurement data control, regulation and visualisation. If regulation requires high real-time deterministics, embedded systems are a better choice because data, while quite small, is also time critical. However, regulation in real-time cannot be implemented on PC-based systems, mainly because resources are distributed uniformly over all components of the PC and control tasks are not processed in real time and must wait in some cases before they can be executed.

In terms of storing results, if only the end results of the test need to be logged or stored, a measurement device with an embedded acquisition system will suffice. However, PC systems are able to store and manage larger amounts of data due to bulk storage options and, in this case, data acquisition software can record the data on a PC in parallel to measurement and control operation.

Conclusion

It is safe to ascertain that the ability to measure torque, rotational speed, angle of rotation and the qualities derived from these variables is increasingly critical in the design of new test benches for use in industrial environments. Likewise, when selecting and designing test benches, higher requirements for accuracy and speed, automation, and efficient operation must be considered.

Overall, the general trend seems to suggest that conventional measurement technology systems and automation solutions are moving ever closer together. Thanks to modern and powerful torque sensors, which can be combined with embedded systems that feature open communication interfaces, systems are now suitable for high-quality measurement and regulation tasks. In addition to controlling the measurement sequence themselves, this type of modern system can also control machines and implement modern, forward-looking and innovative test benches, which in turn, can result in cost and time savings.

How to implement the Industrial Internet of Things

Industrial organizations need an effective way to get started with the Industrial Internet of Things (IIoT). See the ways to get started with IIoT, including appropriate processes, devices, systems, expertise in operations, industrial automation, and controls.

Industrial organisations worldwide are seeking to employ the Industrial Internet of Things (IIoT), a transformative digital evolution focused on Big Data analytics, to improve production efficiency, operational reliability, and supply chain performance. To be successful, operating companies should develop a flexible IIoT framework to enable secure collaboration across sites and disciplines, change work processes to improve information sharing and cooperation between functional teams, and leverage external expertise and knowledge vendors to complement internal resources.

Assets, processes, connectivity

Almost every industrial facility stands to benefit from the emergence of the industrial Internet. On one hand, operating sites with widely distributed assets are frequently limited to localised expertise to manage connectivity and aggregation of data. On the other hand, entrenched traditional work processes constrain many facilities and do not contribute to improved performance and profitability.

Equipment health is an important concern for all types of operations. If an asset fails, too often, there's no logical way to analyse what happened because there's not enough meaningful information, or the right people cannot analyse it until hours or days after the failure.

It is not uncommon for plant facilities to suffer from a lack of visibility to real-time performance against business metrics. They require better techniques for collecting and storing all relevant data in the organisation, visualising information to gain valuable insights, and then predicting and detecting issues and opportunities.

Putting the IIoT into perspective

Today, manufacturers and other industrial firms are contemplating the next step to effectively manage and exploit data at single sites or in enterprise-wide operations. Business success demands that the right decisions are made at the right time with the right information.

A growing number of companies are looking to harness the power of the IIoT. By using machine learning, Big Data, and automation technologies to create a "system of systems" that can accurately and consistently capture, analyse, and transmit data, they hope to achieve greater efficiency, sustainability, and quality control across the supply chain.

The IIoT is the next big evolution in performance and operations, employing existing technologies such as advanced computing, intelligent sensors, mobility applications, cloud-based platforms, and enterprise digitisation to help turn data into actionable knowledge. At the heart of this approach are several key elements:

- Smart and secure collaboration
- Predictive analytics
- Data management and onsite control
- Smart and connected assets and devices.

An effective IIoT strategy relies on consolidating data in the cloud from multiple disparate systems, applying higher level analytics and leveraging experts who are often physically remote from the plant site. Predictive analytic solutions can transform work processes from manual and reactive to automatic and proactive, helping to avoid unplanned downtime and improving performance and safety. They allow businesses to keep closer track of everything going on in the plant, at remote locations, at subcontractor and supplier facilities, and on goods in transit anywhere in the world.

Develop an effective IIoT framework

Several important factors are involved in realising maximum value from the IIoT. Its real power comes from centralising data and then integrating applications to digest and process this information. Instead of deploying applications in a control system, they can be located in the cloud, totally eliminating maintenance requirements in the plant and making additional data available in those applications from multiple sites. Typical applications that add value in the cloud include advanced process control (APC) monitoring, condition-based monitoring (CBM), enterprise data historian, mobility solutions, and scheduling among others.

Industrial organisations should consolidate data from different sources using open integration and

communication technologies like OPC Unified Architecture (UA). This provides support for existing communications protocols so installed equipment is integrated in the IIoT architecture in a secure way. Next, they can move data from the plant to the enterprise and apply smart analytics to extract meaningful information. It is then essential to apply domain knowledge to understanding the data, leveraging in-house expertise, remote subject matter experts, or third-party knowledge vendors.

With a larger, consolidated data set, firms can apply and develop more advanced analytics in the cloud and deploy these analytical models in edge devices for more detailed insight, scale the data as needed to meet the varied requirements of single-site or enterprisewide operations, and take advantage of a wider pool of data experts for monitoring and analysis.

IIoT collaboration, implementation

The true promise of the IIoT is not about the "things," but rather the people who interact with the operation. Organizations that think about connecting people first and then connecting things will be well-positioned to optimise their plant's operations.

The key to the success of any IIoT implementation is a willingness to operate differently, which means acquiring the tools necessary to support new roles, responsibilities, and work processes.

If an IIoT plan doesn't include changes in how functional groups work together, then it probably should be rethought.

Building all of the in-house expertise needed for complex industrial sites is becoming increasingly difficult. As mature markets face the loss of knowledge of retiring baby boomers, the best operations will be those that learn when to develop skills in-house and when to leverage external resources to drive business outcomes.

A major opportunity for the IIoT to improve operational effectiveness is to embrace collaboration with third-party experts. Today's technology makes it possible to securely tap the domain expertise of a whole ecosystem of partners in the cloud, where other organizations such as process licensors and original equipment manufacturers (OEMs) can help solve specific problems. This approach can also extend to internal resources across the globe.

It's no coincidence that the knowledge and experience of OEMs and process licensors can have the greatest impact on the reliability of plant equipment and process operations. The IIoT is not just about monitoring; it's about taking the diagnostic know-how of subject matter experts and embedding it in applications at the edge that can predict and prevent failures.

Ben Blanchette is the strategy and business development manager of digital transformation at Honeywell Process Solutions.

Making alarming improvements

Find out how Interconnector UK solved a two-way remote alarm management challenge on a bi-directional gas pipeline.

Interconnect UK (IUK) is a joint venture company that owns and operates the only physically bi-directional gas pipeline between the UK and Continental Europe. The company is dedicated to the safe, efficient and flexible transportation of natural gas.

The commercial operation is based in central London, with terminals at Bacton in the UK and Zeebrugge in Belgium, joined by a 235km pipeline running under the southern part of the North Sea. The pipeline diameter is just over 1m with a forward capacity of 20 bcm/y and a reverse capacity of 25.5 bcm/y.

The Bacton gas terminal was originally designed and constructed between 1996 and 1998. At this terminal, dedicated shift engineers work 24/7 managing the physical operation of both terminals and pipeline. In addition, at both the Bacton and Zeebrugge terminals, technical teams maintain process plant, instruments, control systems and ancillary equipment.

The terminal boasts four 27 MW gas turbines, which provide the power for the compressors at Bacton to pump up to 58 million cubic metres of gas per day at pressures of up to 140 bar.

The duty senior shift engineer at Bacton is tasked with controlling the compressors and peripheral systems at both Bacton and Zeebrugge to achieve optimally efficient gas flows.

The Zeebrugge terminal was upgraded in 2007 to increase import of gas volumes to the UK. Zeebrugge is operated remotely from the Bacton terminal, although, if required, can be run locally. Remote operation gives IUK centralised control over the gas transportation process, resulting in greater manpower efficiencies.

Best practice alarm management

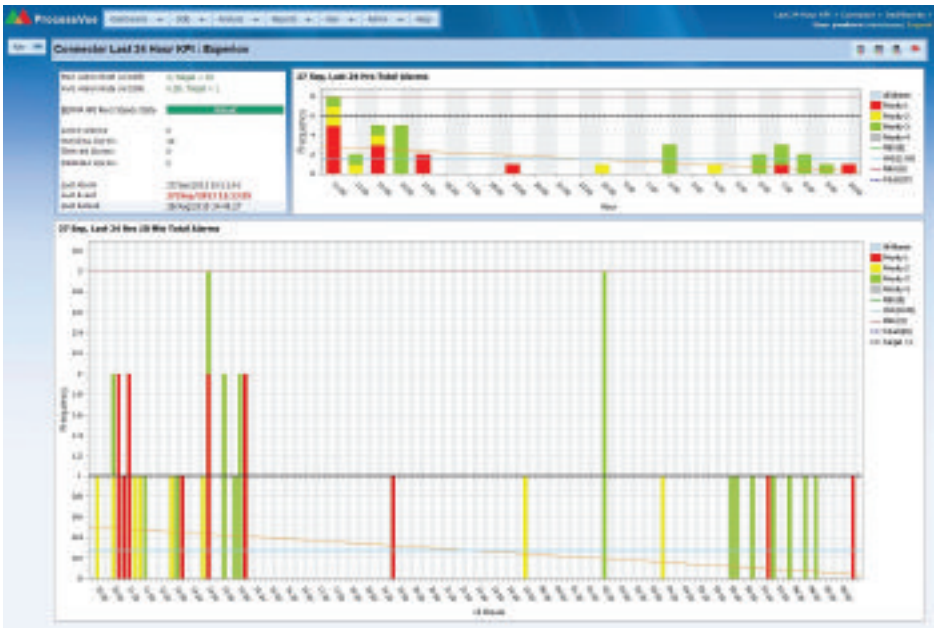
Since its establishment in 1991, EEMUA 191 has become the globally accepted standard for good practice alarm management. Alarm management software should therefore be based on EEMUA 191 guidelines. When IUK carried out an independent alarm system 'Health Check' and GAP analysis to benchmark its alarm management system against the EEMUA 191 guidelines it was identified that the system required improvements.

Bacton and Zeebrugge each has its own separate, but identical, SCADA system. Alarms and events are therefore generated locally at each site. Because the Zeebrugge site is normally unmanned and remotely operated under normal operating conditions, Bacton is responsible for responding to alarms.

However, there is no centralised Alarm Historian and so it was not possible to measure alarm loads on operators due to these separate databases and reporting systems. It was difficult to merge the two separate SCADA databases together and so each terminal reports on its own site.

Alarm analytics was limited within each separate SCADA system. HSE has best practice guidelines on the number of alarms that a single operator should deal with in a certain time period – including the grading of alarms into high priority (i.e. immediate response) and low priority. With two separate SCADA systems and no central alarm analytics, these critical KPIs were not available to IUK.

As well as the GAP analysis, IUK also carried out a market assessment of current alarm management products and ProcessVue from M.A.C. Solutions scored highest. The ProcessVue suite



includes an Alarm Historian, Alarm Analytics and a Master Alarm Database. The software is modularised, scalable and built using modern technologies.

Ease of use has been the development philosophy of ProcessVue. A cumbersome, difficult to use application that requires days of training to get to grips with simply discourages people from using it. Such tools may not be used everyday – they may only be needed when there is a problem or after a problem for investigation purposes – so it needs to be intuitive.

ProcessVue also contains a fully configurable report scheduler allowing the administrator to select single or groups of reports, the desired timeframe and output method (email, file or print). Once it is configured correctly, the software delivers the information you want, when you want it.

Challenges

The environment at IUK raised many challenges. There are two SCADA databases located on different continents and in different time zones, which needed to be 'stitched' together in chronological order for analysis. M.A.C. Solutions needed to consider the mode of operation. In normal operating mode, alarms from the Zeebrugge end of the pipe need to be counted against the Bacton operators, but when Zeebrugge operators are in control of that end of the pipe, the alarms need to be counted against them.

Then there is the flow direction to consider. Forward mode is from Bacton to Zeebrugge; reverse mode is Zeebrugge to Bacton. Alarms needed to be identifiable depending on this. The operators also wanted to be able to see, in isolation, alarms from each unit and to be able to compare one unit to another. For example, to compare alarm loads from Bacton compressors to the Zeebrugge compressors when in a certain operating mode. To achieve all this required some modifications to ProcessVue and to the SCADA system in terms of how it recorded the alarm data. The SCADA modifications were performed by the vendor with input from M.A.C. Solutions.

ProcessVue Collector software was installed at both ends of the pipe. The collector has the function of sucking the data out of the local SCADA database. The existing wide area network VPN between the two sites was utilised to transmit the data from Zeebrugge to the ProcessVue Archiver software at Bacton. The Bacton collector does the same locally. The Collector looks for an ascending Record ID within the SCADA database to keep track of where it has read up to. During testing it was discovered that under certain circumstances this Record ID could be reset by the SCADA, which confused the Collector. Other behavioural issues with the SCADA were also discovered so the Collector software needed to be modified to handle each scenario.

The ProcessVue Archiver has the responsibility of receiving the cleaned data from both collectors and storing it into a local SQL database after parsing. Parsing is the act of separating each message into its individual components. For example, the mode of operation needed to be identified, flow mode, who was in control, which unit the alarm came from, etc. All of this is achieved with parsing. Each element is stored in a specific field within the ProcessVue database and is available to see using the ProcessVue Client.

The Client was configured to show alarms from each unit using 'Windows'. Each Window of data shows the alarms from a particular unit. Additional Windows were then created containing all the alarms when Bacton are in control, and all alarms when Zeebrugge are in control. This allows IUK to perform accurate alarm analysis across different units and to get an accurate picture of the number of alarms operators have to deal with.

Commenting on the solution, Rob Gibson, instrument and controls engineer at IUK said: "We worked alongside M.A.C. to produce a system that carries out all the necessary database analysis in the background, and which also provides detailed reports that are easy to produce alongside a user friendly interface. We hope to continue working with M.A.C. Solutions in the future as we further improve our SCADA alarm handling."

Know the risks of securing safety systems

Even if a safety system is isolated and separate from a network, cyber attack potential remains, and companies and users need to take necessary precautions to lower risk, especially with increased connectivity via Industrial Internet of Things.

One assumption about safety systems is they need to remain isolated from the control system, ensuring nothing will hinder their mission to keep the plant and workers safe.

If we have learned anything in this cyberaware world, isolation is not security. That means no matter if safety is separate, integrated or interfaced, there is always a path in, especially as companies increase Industrial Internet of Things (IIoT) connectivity.

In these days of working in open, connected manufacturing enterprises, security threats hover over a facility like a looming blizzard, potentially undercutting the vast ability connected plants have to reduce cost and increase productivity and profitability. Control systems, and just as importantly, the safety system, need to stay secure.

That means the manufacturer needs to treat its safety systems like any other in a facility and conduct a risk assessment to understand any and all strengths and weaknesses.

"The risk-assessment process is the same as with a control system in that you have to identify the system and how it interfaces with the rest of the system, which is pretty critical," said John Cusimano, director of industrial cybersecurity at aeSolutions. "Generally speaking, it is always best practice to treat the safety systems as its own zone and then you perform a risk assessment on that safety zone."

While the process control system and safety system have similarities, there is one major distinction.

"The biggest difference with a safety system is the consequences," Cusimano said. "When you do the risk assessment in the safety system zone it comes out at a higher risk, it will change your protection and your decisions on how you are going to secure that zone. It will be a higher level of security and require stronger mitigations. Generally, you are trying to minimize the communications and reduce the attack surface."

Safety systems remain a vital cog not just in keeping the plant and people safe, but also enabling successful business performance.

"We have to remember something that is very important-something security professionals don't always remember: The existence of our group is to enable business performance," said Jay Abdallah, director of cybersecurity, EMEA, Schneider Electric. "That needs to be our number one objective. Safety falls directly in line with those business objectives in keeping people safe, keeping the plant safe, keeping reputations safe, and keeping equipment safe which tends to help the bottom line."

Knowing which direction a safety system attack could come from is a top priority.

"The biggest thing users are coming to realise is the attack will most likely come from inside the network than outside," said Sven Grone, industrial automation turbomachinery control business development at Schneider Electric.

"Things like inadvertent viruses on flash drives, contractors coming in with their machines and hooking up to the network to work on gear. These are people you invited into your systems to work on it, and you are not controlling their machines and not controlling what they are putting on the network. There is definitely an element of social engineering and having to deal with people's behavior and operational behavior in the cybersecurity process that is often not nearly as prevalent than doing functional safety," Grone said.

Security whether separate or integrated

When it comes to securing a safety system, the age-old question of integrated or separate systems continues to rear its ugly head.

"I am a personal believer in a separate system. The little amount of money you save making it integrated is just the engineering portion of it," said Nasir Mundh, global director of safety services at Schneider Electric. "To me a project is two years or three years where you design it, install it, and run it. After that, the plant is running for 25 to 30 years. So you are adding

additional risk to the process for 30 years just to save some money in this two-year project. To me that never makes sense. A distributed control system (DCS) or a control system is a workhorse, it is doing something every single moment. It is controlling the plant. That whole line has commands going up and down, and now you have a safety system sitting on that same network. It is opening yourself up to risk."

"Integrated systems have some advantages with operations and the communications between the safety systems and the DCS. However, if you have an integrated system and you somehow are breached, there is a very high chance you lose both layers of protection," said Farshad Hendi, safety service practice lead, Americas and EURA at Schneider Electric. "That means someone is in your house, and the halls are somehow connected together. If the systems are separated, it is not impossible to do that, it is more difficult."

Maintain vigilance

No matter the type of system, vigilance remains the key priority.

"Integrated, interfaced, or separate. There is no right, no wrong, only choice," said Steve Elliott, senior director offer marketing for process automation at Schneider Electric.

"An upstream operating company had integrated control and safety," Elliott said. "There was a master clock on the network that had a fault develop that was broadcasting a time across the network to all the controllers. Eventually it bombarded the controllers to the point they stopped, and they had to do a shutdown on the platform and had to black start. All the power on the platform had to be dropped, and they had to vacate it. They had integrated control and safety and a failure mode that actually caused them to shut the platform down. When you look at it, they didn't do a failure mode effect analysis.

"We integrate safety and now security becomes an issue – we are seeing a movement back to maintaining as much distance between the control system and safety as possible," Elliott said. "Thinking about moving toward open standards and connecting everything together, next security is a consideration – solving one problem, creates another."

Gregory Hale is the editor and founder of Industrial Safety and Security Source (ISSSource.com), a news and information Website covering safety and security issues in the manufacturing automation sector.

Robust rotary encoders

HEIDENHAIN (GB) has introduced a pair of new, sealed, incremental rotary encoders with reinforced bearings which are capable of withstanding high axial and radial loads of up to 75 N, making them suitable for use in demanding environments.

The IP66-rated ROD 600-series encoders can provide accurate feedback of rotary speeds up to 12,000 rpm and may be used in temperatures of between –20°C and +85°C and relative humidity up to 93%. Five different line counts can be specified from 512 to 5,000, accuracy being ± 1/20th of the grating period.

Both models in the range include a flange that allows axial or radial connection and a solid, stable shaft of 15mm diameter with key. Typical applications are said to include heavy duty machine tools, off-road vehicles, printing and textile machinery, paper production plant and steel mills. Numerous shaft couplings for interfacing the encoder with the rotating mechanism can be supplied.

CC-Link IE cables and connectors

Phoenix Contact is helping customers to future-proof their machines and processes by offering a range of cables and connectors for CC-Link IE in addition to its existing range of CC-Link fieldbus network cables. A new M12 connector for CC-Link IE, for example, is based on the X-coded interface connection standard.

Industrial PCs for tough environments

Distec is now stocking the Wincomm range of 15, 19 and 21.5in fully water proof industrial PCs which are suitable for use in tough environments.

The Wincomm range is particularly designed for use in the food and beverage industry, abattoirs and chemical plants, where PCs can be exposed to dangerous or unhygienic solids or liquids. The PCs are housed in stainless high strength anti-corrosion housing, so will not wear over time.

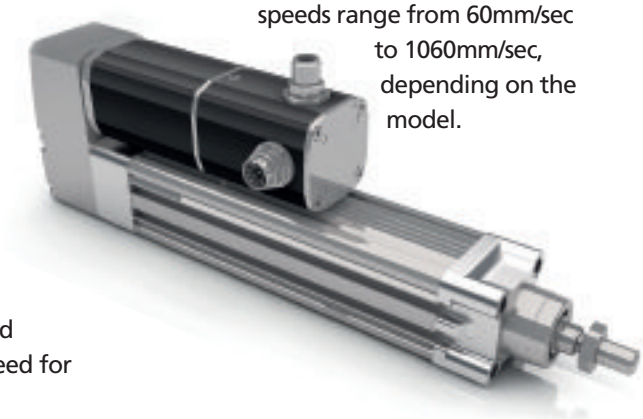
The Wincomm PC's feature a fanless design which removes the need for ventillation and allows the equipment to be fully sealed without overheating. The PC's also have a special thermal design with anti-condensation features, to ensure that while they are fully enclosed, the screens will still be visible in all environments.

Electric cylinders as a pneumatic replacement

The increasing demands of modern manufacturing to improve performance and productivity and to minimise downtime and product rejections, means the focus on how to meet these challenges is becoming more important. This has resulted in a growing awareness of the potential cost-saving benefits which can be achieved by replacing traditional pneumatic cylinders with electromechanical alternatives in a wide range of applications. A good example of this is the CASM series of electric cylinders which are powered by brushless DC motors and ideal for applications requiring fast and powerful movements.

Developed by DUNKERMOTOREN, CASM electric cylinders offer a good replacement for pneumatic cylinders as their technology can also effectively reduce contamination, maintenance and noise. They also eliminate the need for hoses, running compressors and other equipment associated with operating pneumatic cylinders. Integration into existing systems is simple, as they are supplied as a complete package solution with features such as a user-interface which enables easy setup and operation, even for a non-expert.

The cylinders are available in three different modular options designed to seamlessly fit standard footprints of pneumatic cylinders. Stroke lengths range between 50mm and 800mm, load capacities from 300N to 5400N while speeds range from 60mm/sec to 1060mm/sec, depending on the model.



ELECTRICAL AUTOMATION: innovations on show

SPS/IPC/Drives once again returns to its regular venue, Nuremberg Messe in Germany, from 22 to 24 November.

The annual SPS/IPC/Drives exhibition is looming once again bringing industry together to provide a comprehensive overview of individual components and complete solutions for electrical automation and showcasing many pioneering technologies of the future. This year the event will host over 1,600 exhibitors, bringing together all the latest learnings surrounding automation and drive technologies across a total of 14 halls.

Focus on Industry 4.0

Due to the positive reaction of visitors last year, and the increasing challenges facing industrial production, Hall 3A will once again be home to the Industry 4.0 Area. The area will provide a focus for visitors interested in obtaining information about digitalisation and the intelligent networking of production. "The use cases of the Industrie 4.0 Area are selected in such a way that you can identify small steps which enable you to develop on an evolutionary basis in the direction of Industry 4.0. This is of great benefit to machine builders," said Dr Peter Adolphs, CEO at Pepperl+Fuchs GmbH.

Another popular area of the event is the 'Automation meets IT' joint stand and forum which presents data-based business models as well as IT-based solutions from the world of automation en route to the digital production of the future. The 'MES goes Automation' joint stand will show how order processing and production processes can be optimised through the use of MES. For the first time this area will include companies from the field of cyber security, such as Airbus Defence and Space, the German Federal Office for Information Security, and Kaspersky.

Other joint stands at the event include the 'AMA Center for Sensor Technology, Measurement and Testing Technology' in Hall 4A and 'Wireless in Automation' in Hall 10, which offer visitors specific and comprehensive information on the respective topics.

Siemens will once again be taking an entire hall – the Frankenhalle – at the event. Visitors to the stand will be able to find out more about how digitisation is changing the industrial world with

Siemens Sitrans TO500 is a fibre-optic multipoint temperature measuring system.

a series of interactive demonstrations, numerous use cases and the latest software and hardware innovations designed to simplify the engineering of complex functions for controllers, drives, and automation.

Siemens open cloud platform, MindSphere, forms the centerpiece of the company's eco-system, demonstrating its data analytics and connectivity capabilities, tools for developers, applications and services. Don't miss the specially created MindSphere Lounge, which will form the backdrop for visitors to experience a variety of new dimensions and be transported by the ideas and applications presented by Siemens, and its partners and customers.

Siemens will also be introducing Version 14 of its TIA Portal Integrated automation tool which is designed to reduce complexity, increase flexibility and make systems and processes more transparent. The latest version aims to further shorten time to market, by means of simulation tools, and increasing plant productivity through the introduction of additional diagnostics and energy management functions. The new additions are said to benefit system integrators and machine builders as well as plant operators.

Also on display for the first time will be the Sitrans TO500, a fibre-optic

> p22

multipoint temperature measuring system. It enables complex temperature measurements and detection of the precise position of critical over-temperatures – for example in tube and tube-bundle reactors. The Sitrans TO500 is characterised by a large number of measuring points (up to 48 per measuring lance, depending on the temperature range) and the small diameter of the sensor measuring lance. The precise determination of the temperature profile enables users to detect critical operating states in good time and initiate countermeasures. The measuring system is said to be particularly suitable for use in the chemical industry.

PC and EtherCAT-based control

Beckhoff will present the entire portfolio of its PC and EtherCAT-based control technology. Divided into five forums, its stand will provide an overview of the comprehensive range of products and systems available. New product innovations will be introduced across all areas of technology. Maximally scalable automation, motion solutions and Industrie 4.0 areas will house demonstrations of the companies capabilities.

The company will present its new device series for high-end measurement technology. These precise, fast and robust measurement technology modules are becoming a more integrated part of PC-based control solutions. The EtherCAT measurement technology modules can be directly integrated into the modular EtherCAT communication system and combined with a portfolio of over 500 EtherCAT Terminals. The company says that high-precision measurement technology reduces the use of raw materials and energy in machines and plants while forming the basis for condition monitoring and predictive maintenance. So, with its new EtherCAT measurement technology modules, it says that high-end measuring devices and traditional automation technology can be combined into one universal system.

Beckhoff will introduce a new range of EtherCAT measurement technology modules.

As IIoT networks grow, the security of devices becomes vital. Moxa´s new firmware -Turbo Pack 3 - is compliant with the IEC 62443-4-2 level 2 cyber security standard, and also supports other security management features, such as MAC Address and RADIUS authentication, to prevent unauthorised access, known security leaks and unknown attacks.

Cyber attacks

According to an ICS-CERT report, cyber attacks on the critical manufacturing sector increased by 50% from 2014 to 2015. The report noted that a lack of proper access management and network probing are among the most common network vulnerabilities. One of the key mechanisms to ensure a safe and reliable network is to strengthen device-level security. Turbo Pack 3 ensures Moxa's switches comply with the IEC 62443-4-2 level 2 standard, which provides technical security requirements and guidelines for network device suppliers and engineers. The firmware upgrade also supports enhancements in redundancy technologies. With these new functionalities, Moxa's switches are able to enable higher network availability and reliability, which is crucial for mission-critical applications.

B&R will be presenting the SuperTrak industrial transport system at the show which enables agile, efficient production at any batch size. Also on show will be a multitude of new mapp components and connected manufacturing solutions based on OPC UA communication.

Two years ago, the company radically simplified the development of machine software with the introduction of mapp Technology. These software components simplify low-level programming tasks for basic functions freeing up OEMs for other tasks. B&R has continued to expand its software framework – offering further savings for customers developing applications in the areas of CNC, robotics, complex closed-loop control and HMI.

B&R will also be taking the opportunity to present numerous communication solutions for the connected factory envisaged by Industry 4.0. By combining OPC UA and openSAFETY to create Safe Line Automation, the company offers seamless and scalable safety throughout integrated production lines. It will also be presenting a cloud solution for its APROL process control system.

The FDT Group will be launching an integrated FDT/Industrial Internet of Things (IIoT) architecture which has been created to bridge the process, hybrid and factory. The FDT Group's goal is to make the IIoT a reality via an ecosystem of automation vendors promoting interoperability, security and mobility through tomorrow's new adaptive manufacturing assets. As such, it is preparing to modernise its identity and will be providing new information resources for the global automation market.

The association will also be using the event to release the FDT/OPC UA annex, enabling sensor-to-cloud, enterprise-wide connectivity. Automation system manufacturers can implement this annex into the FDT/FRAME. Suppliers with an FDT/FRAME embedded in their DCS, asset management system, PLC or other system have the ability to include an OPC UA server in an application accessible from any OPC UA client application.

CIP annex

Also set for release is the ODVA Common Industrial Protocol (CIP) annex. Network adaptations of ODVA's media-independent CIP protocol include EtherNet/IP, DeviceNet, CompoNet and ControlNet. The CIP annex enables the

use of ODVA networks and Ethernet IP in the latest FDT/FRAME Applications.

The CLPA will be launching the latest iteration of CC-Link IE, CC-Link IE Field Network Basic, while announcing the release of the CC-Link IE/PROFINET interoperability specification along with PROFIBUS & PROFINET International (PI). It was only last year, at SPS 2015, that a cooperation agreement between the two organisations was announced with a view to achieving seamless communication between CC-Link IE and PROFINET. The release of the specification this year signals the delivery of the promised interoperability between the two networks, which addresses the needs of end users in both Asia and Europe.

CC-Link IE Field Network Basic is the latest technology from the CC-Link IE open gigabit Ethernet, which brings CC-Link IE compatibility to 100Mbit devices by implementing software at both the master and device level. It is intended to greatly increase the accessibility of CC-Link IE to companies whose devices are not yet ready to support gigabit Ethernet. Existing 100Mbit devices can now have CC-Link IE compatibility added purely though software development. Because no hardware development is required, implementation of master stations on industrial PCs is also simplified. CLPA-EU general manager John Browett said, "The new Basic version helps to provide a well-rounded solution to all levels of the market. Companies who are looking to offer maximum performance can choose the gigabit version, while those who wish to stay with 100Mbit Ethernet for now can choose Basic mode to leverage our other benefits. However, in the end the real winners will be machine builders and end-users who will have an even greater freedom of choice when specifying CC-Link IE systems."

Sercos International, provider of the Sercos automation bus, will be presenting a variety of Industry 4.0-capable demos.

In the current motion controls and motion logic systems for hydraulics, Rexroth has moved numerous functions that were previously regulated on a purely hydromechanical basis into software. In the process, the particularities of the fluid technology are automatically compensated for. The decentralised controls execute their tasks autonomously and communicate with superordinate PLCs via open communication interfaces. This allows users to use the physical advantages of hydraulics in an Industry 4.0 environment. This will be demonstrated by a new hydraulics demo from Bosch Rexroth on the Sercos International stand.

The Sercos SoftMaster Demo scores points with an open 'upward' and 'downward' communication link. The demo is based on a Sercos III SoftMaster core, which was developed in cooperation with Bosch Rexroth and is being made available as open-source software.

Thanks to the Sercos III SoftMaster, a Sercos III FPGA or ASIC master component is not required. Instead, a standard Ethernet controller is used, with the Sercos III hardware functions emulated in host-based driver software. With this implementation approach, adequate real-time behavior is ensured for a large number of applications. If an Ethernet controller is used, even the synchronicity and the highest availabilities of a hardware-based master can be achieved.

This latest solution allows engineers and control manufacturers to use an industrial PC without special fieldbus hardware and without PCI slots to control the machine. Due to the use of the Sercos SoftMaster in combination with the powerful Intel I210, the CPU load is reduced significantly, while costs and space are also saved.

The Ethernet Powerlink Standardization Group (EPSG) will be using the event to demonstrate how POWERLINK can be used to create interface-free networks for the smart factories of the future.

Internet-free networks

The Ethernet Powerlink Standardization Group (EPSG) will be using the event to demonstrate how POWERLINK can be used to create interface-free networks for the smart factories of the future. The stand will also display new POWERLINK products from Weidmüller and Danfoss - solutions for seamless integration of robotics controllers in POWERLINK networks.

Another focus of the stand will be on seamless integration of robots into POWERLINK networks. Visitors will see implementations from KUKA, Comau and more. They will also get to see the progress being made on a robotics project being developed by students at the University of Poitiers for submission to the Industrial Ethernet Awards.

Testbed to integrate sensors into SMART FACTORIES

Daniel Walldorf and *Michael Hilgner* discuss the work which is being undertaken to connect existing sensors to Cloud-based IT systems, to allow them to become part of a smart factory.

Implementing applications for the Industrial Internet of Things (IIoT) requires the analysis of a great deal of production data (Operational Technology, OT) in IT systems. However, for many this is still a difficult task due to limited OT/IT connectivity.

To help overcome this issue, TE Connectivity (TE) and three partners have set out to implement a testbed that shows how existing sensors can be connected to the cloud and machines upgraded for smart applications under the umbrella of the Industrial Internet Consortium (IIC). The core component is a smart I/O module, which TE will be presenting in prototype form at this year's SPS IPC Drives event.

The IIoT, Industry 4.0 and Smart Factory are essentially based on a comprehensive digitalisation of factories. The aim of the IIC is to develop an IoT ecosystem in which appropriate solutions are discussed, described and tested. One of the key activities of this open organisation, which already has more than 250 members, is creating experimental platforms (testbeds) that will be used to put future technologies, products and applications through their paces to find out whether they are feasible and what benefits they offer to users.

One example of this is the previously mentioned testbed for connecting existing sensors to the cloud. TE, SAP, ifm and the OPC Foundation are using this to demonstrate that energy consumption can be sustainably reduced using an intelligent solution covering everything from capturing, transporting and processing the data, to optimising the process. The testbed includes a variety of software tools and a hardware component for simple integration into existing systems that are used to transfer information from the machine to the IT system via an OPC Unified Architecture (UA) interface.

Although sensors in machines already record a great deal of information, only a fraction of it is available for analysis. TE's research indicates that, on average, controllers process only 5% of the data. By changing their programming, it would be possible to access the remaining 95%, but apart from the fact that not all components have sufficient computing power, this approach is very complicated.

In addition to the controllers, the data models for automation components – such as sensors, actuators and motors

– which are usually made available via connected gateways, also need to be adapted. This needs to be done for each of the manufacturers machine types, resulting in high costs, as well as unpredictable risks for the uptime of the machines.

The alternative

The alternative is to capture the data at sensor level, although this would require smart connectivity technology that gives intelligence to simple field devices. For this reason, TE has developed an I/O module for the IIC test bed, which, in addition to its I/O functionality, acts as an Edge computer. Usually, I/O modules capture data from sensors and actuators and forward it to the controllers via a higher-level bus system. With the smart variant, a further communication path can be set up in addition to this real-time route. This can be used to aggregate data for monitoring the machine's energy consumption and then transfer it to the IT system without impairing the performance of the control network.

Because I/O modules are already available in machines today, they can easily be replaced without changing their architecture or interfaces. The semantics of the data models used to describe the remotely configurable I/O Link sensors of the IIC test bed are also defined in the open IIOD standard (I/O Device Description). This means that these sensors are not only very easy to integrate into the IT system, but all their data can also be managed there.

TE has now further developed the smart I/O module into an independent cyber-physical system that effectively bridges the gap between the world of automation and the world of IT. It is easy to retrofit and highly versatile, not merely for monitoring energy consumption but also for other applications that can be used to boost productivity, such as predictive maintenance.

The prototype of this system – IoT OmniGate – comprises hardware plus an administration environment and a data management tool. The hardware provides interfaces both to conventional sensors for factory automation, such as I/O-Link via M12, and for communication with the SPS via Ethernet – the prototype supports Profinet, but will also support other protocols in the future. There is also an Ethernet interface for connection to the IT/cloud.

This interface can be used to set up the IT connection for the sensors and controllers and to generate IP interfaces for passing on the recorded data in structured form to other applications which means that the data no longer has to be requested from different locations. The data is also always in the same format, which makes work a lot easier.

Pilot projects are alredy showing how factories can benefit from smart connectivity technology. These projects, which are geared to the classic value drivers that form the basis of operational excellence (resources, plants/processes, work, inventories, quality, safety and flexibility), have made it possible to improve overall equipment effectiveness (OEE), something that would previously have taken about a year has been achieved within three months. How the value drivers are weighted in each case varies from company to company, in this respect, digitalising the factory offers new technical possibilities that can be used to cost-effectively improve the classic value drivers.

Conclusion

The IIC test bed demonstrates how smart connectivity technology helps connect data from existing sensors to the cloud and then analyze it in an IT system in order to increase process efficiency – in this case, monitoring energy consumption. Existing infrastructures in particular need upgradable solutions that minimise downtime, save costs and increase productivity. Pilot projects at TE's own factories have shown that this approach also works in practice.

Daniel Walldorf is Industrial IoT Platforms & Ventures at TE Industrial; Michael Hilgner is Manager Consortia and Standards at TE Connectivity.

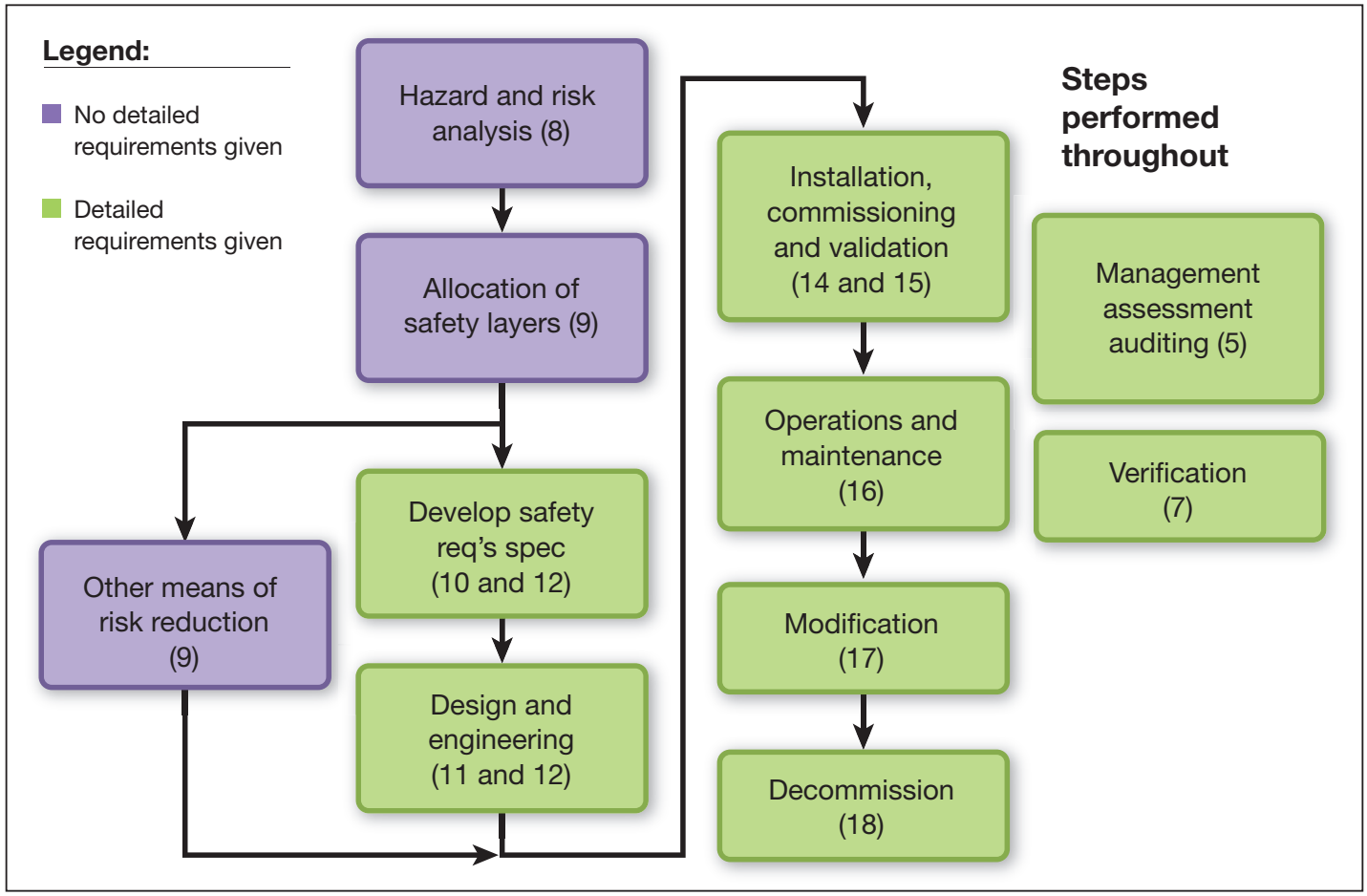
How to keep process facilities safe

Proper safety management can be taken to minimise risk.

Modern industrial life has its rewards, but it also comes with risks. There is no such thing as absolute safety or zero risk. When major industry accidents happen, regulations often follow. In 1992, 29 Code of Federal Regulations (CFR) 1910.119 "Process Safety Management of Highly Hazardous Chemicals" was released by the Occupational Safety & Health Administration (OSHA) in the U.S., after several major process industry accidents. Other parts of the world have similar regulations. These regulations acknowledge that there is no such thing as zero risk, yet there are still expectations from companies to operate safely. How safe is safe enough?

In deciding an acceptable level of risk, some look at risks that society readily accepts, such as the 35,000 people who die in the U.S. every year in vehicle accidents. That 1 in 10,000 people-per-year risk has produced little public or government outcry, so it would appear to be a tolerable level of risk.

Modern automation and control systems are very reliable; however nothing is perfect, everything fails, and it's just a matter of when. Process facilities need multiple, independent layers to maintain



This is an illustration of the functional safety lifecycle (with numbers referring to ISA 84 / IEC 61511 standard clauses). Image courtesy: aeSolutions

safety, including integration of alarms, safety instrumented systems, pressure relief devices, scrubbers, flare systems, and fire and gas systems, among others. Layers shown in Figure 1 are used to lower risk in a facility.

OSHA expects organisations to follow recognized and generally accepted good engineering practices (RAGAGEP). For alarm systems, ANSI/ISA 18.2-2009 "Management of Alarm Systems for Process Industries" is the recognised standard. For safety instrumented systems (SIS), ANSI/ISA 84 (IEC 61511 Modified) "Functional Safety: Safety Instrumented Systems for the Process Industry Sector" is the recognised standard.

The first edition of ANSI/ISA 84 was released in 1996, the second edition in 2004, and a third edition may be released by the end of 2016. It is a performance-based standard. It does not mandate technologies, levels of redundancy, test intervals, functional logic, how to implement bypasses, or any other details. It does not state what levels of risk should be tolerable for the industry or any particular company. After all, the standard was written for the entire process industry; what is applicable for one facility may not be applicable for another.

The ANSI/ISA 84 standard is essentially a cradle-to-grave approach. A hazard and risk assessment is performed to identify hazardous scenarios (such as, what might go wrong) and evaluate the risk of each scenario (how often and how serious). This will eventually lead to the inputs, outputs, logic, and performance required of the SIS. A safety requirement specification (SRS) needs to be written to document the more than two dozen details needed to adequately design each safety function. Most safety system problems originate from this step not being completed properly. The system will then be designed, tested in the factory, installed at a facility, and compared against the original specifications (as things may have changed over the lifespan of the project). The system will then require periodic inspection, testing, and maintenance. Any changes that may be required will need to go through a thorough management of change review process.

With the pervasive use of control systems and computers—operational technology (OT)— and use of commercial off-the-shelf (COTS) hardware and operating systems, there is an increased risk and concern of cyber attacks. Many attacks have been documented, and their frequency is on the rise. The issues are similar to industrial technology (IT) systems. Hackers may steal intellectual property, take over the control system, cause physical damage, or shut down a facility. The ISA 99/IEC 62443 series of cybersecurity standards was developed to protect facilities from these sorts of risks. Like the safety system standards, the cybersecurity standards also are performance-based and based on a lifecycle set of activities.

Advancements in safety technology

Control systems, alarm systems, safety instrumented systems, and fire and gas systems represent technologies used to keep process facilities safe. In addition to standards and regulations, there have been many developments to these systems. Most process facilities were controlled in the past using a combination of programmable logic controllers (PLCs) and distributed control systems (DCSs). Modern systems are a hybrid blend of the two and have speed, processing, and communication with capabilities beyond the early generation systems (that are still running in many facilities).

Paul Gruhn is a global functional safety consultant with aeSolutions, located in Houston, Texas.

Firewalls: vital for a successful security model

Tobias Heer, Oliver Kleineberg and *Jeff Lund* discuss firewalls – what they are and what they do.

Firewalls are essential for ensuring network security and increasing system robustness and resiliency. No sound security model can do without them. There are a variety of firewall devices, each with different technical characteristics, hardware features and industry approvals.

Firewalls protect networks and devices from unauthorised access by preventing network traffic to or from these systems. As a core element of network segmentation, firewalls play a critical role in any network security strategy.

At a high level, the goal of a firewall is to secure the link between a company network and industrial network to protect against external threats; separate devices within the network from each other to prevent internal issues from spreading; and permit only certain communications between devices to protect against malicious attacks and device or operator errors.

On a technical level, a firewall's function is to filter packets. After inspecting each packet to determine whether it corresponds to an approved traffic pattern, firewalls filter or forward packets that match these templates, or rules. As an example, rules can include:

- Communication from within the network can only take place with a specified server on the outside.
- Only PCs used for remote maintenance can be reached from outside the network.
- Write-commands for the Modbus/TCP protocol are only permitted from the maintenance terminal.

There are two primary security methods that use firewalls to protect the network. These strategies work together and complement each other for a holistic approach to network security.

1. **A Zones and Conduits approach** limits communication between participants in internal networks, and blocks various network areas from each other. This adds additional defence layers to build a more resilient network in case one area is compromised.
2. **A Defence in Depth approach** provides multiple layers of defence, in contrast to just one defence mechanism, like a single firewall. This design deters attacks against networks through a set of layered defenses so an attacker must defeat multiple security levels.

There are two broad firewall categories – host and network firewalls. Host firewalls are installed on a computer or are provided by the operating system as a software feature. Network firewalls are devices that are specifically developed for use as a firewall, and are placed in the network rather than on a PC. Network firewalls are important security elements for industrial facilities when dealing with multiple networks or when wired and wireless technologies are combined.

Three main types of firewall mechanisms offer different levels of packet filtering:

Stateless firewall – Communication between devices occurs in various phases, or states. The communication relationship is usually initiated in a first phase, and active communication is conducted in a second phase, with the connection ending in the third phase. Stateless firewalls only determine which individual devices or applications may communicate with one another. They cannot determine whether the communication follows normal procedures or recognise and prevent attacks resulting from abnormal behaviour. Stateless firewalls are often characterised by very high throughput performance. In contrast, they will not protect against erroneous or spoofed communication requests.

Stateful firewalls – Stateful or state aware firewalls monitor the communication process and use the recorded information as an additional decision metric for packet filtering. Attacks that attempt to communicate over established connections can often be recognised and prevented. Attacks using specific communication patterns to overload a system can be prevented as well.

Deep packet inspection firewalls – An extension of stateful packet inspection, deep packet inspection firewalls go a step further to examine the full packet to find highly specialised attack patterns

hidden deep in the communication flow. These firewalls offer a high degree of security, as they often provide filtering mechanisms that can be highly individualised and finely configured, but they do demand lots of computing power to implement.

Firewalls can protect a company against threats from the inside and outside. The overall protection from outside threats stems from IT firewall solutions placed in a company's data center. They can also be implemented in production to separate the production network from the rest of the company network. Depending on the location of your firewall, there are other elements to consider.

Firewalls in a WLAN – Communication from wireless to wired networks should also be controlled by firewalls. If a client is connected to a wireless local area network (WLAN), they can communicate directly with all other devices in the same network. An attacker can attack a client that is connected to WLAN, then extend that attack to any other device on the network. Firewalls can be used to restrict the forwarding of messages between WLAN clients at the WLAN access point to increase the overall security of the network.

Firewalls at the field level – A sound security strategy also addresses threats that lie within the network. If communication outside the facility is only supposed to be possible with a single device, the firewall can allow this connection, while preventing other communication attempts. Since the physical demands put on a firewall within a network differ from the demands put on a firewall between networks, usually due to the installation area of the device, field-level firewalls require particular attention to the specific application parameters, such as temperature and vibrations.

Firewalls in a small cell or external site – Industrial firewalls with router functions are suited to smaller external sites. Through this, remote work sites can connect to the rest of the company's control infrastructure via a cellular network. The firewall controls the flow of network traffic going in and out of the external site's local network and creates a border between the company's own network and an external network.

Design considerations

Filtering differences, environmental concerns and whether a management tool is needed should be standard considerations for teams in their search for a firewall solution.

1. Look at differences in filtering: Depending on how you will use it, various filtering mechanisms will be needed. First, determine how in-depth a firewall can go when observing the communication between devices.
2. Environmental concerns: Firewalls should be able to withstand extended temperature ranges, significant vibration and other environmental factors. They should also be compliant with all industry standards and approvals, and designed for use in special areas, such as energy supply, hazardous locations and transportation applications.
3. Tailored for your specific needs: Firewalls should be able to accomplish very specific tasks that support a team's custom needs and applications. For example, if the application end devices require a specific firewall behavior due to the use of unique communication patterns and the firewall cannot support this, it's wise to keep looking.
4. Use a proper management tool: When using multiple firewalls, teams need to be able to effectively manage and configure the devices. Without a powerful management tool for simple and mass configuration of firewalls, the tasks can be very time-consuming and error-prone. It's important that firewalls can be centrally monitored by network management tools to keep things running smoothly.

Firewalls are just one component of a modern security strategy, but are the cornerstone that holds a holistic security model together. By implementing a holistic defence strategy that combines different firewall functions and positions them within the network according to their strengths, engineering teams can design networks that are prepared for the future.

Tobias Heer has been with Belden since 2012 and specialises in topics that revolve around security and wireless in industrial control systems; Oliver Kleineberg joined Belden in 2007 and he is responsible for Advance Development within Belden's Industrial IT platform; Jeff Lund is a senior director of product line management in Belden's Industrial IT group.

Cyber security: a threat to Industry 4.0 implementation?

Barry Graham offers advice on ensuring plant network security in an era of the open enterprise.

Whatever the mode of access, and despite the efforts of governments and other agencies to make industry more aware of cyber threats and their consequences, it is evident that many of today's industrial networks remain vulnerable to cyber attack and so measures to protect them must be taken.

If the benefits of Industry 4.0 are to be delivered networks in the future will need to be more open and therefore will be at an enhanced risk of cyber attack.

The smart factory – perhaps more accurately termed a cyber-physical production system (CPS) – will comprise not just 'smart' machines, it will incorporate warehousing systems and all manner of discrete and process production facilities.

Industry 4.0 inspired implementations of the CPS will need end-to-end ICT based integration of production systems, from factory floor automation to the manufacturing execution system; moreover, they will be subject to extensive web and third-party cloud-based exposure, so tackling the threat of attacks is vital. The potential risks – compromised intellectual property, brand damage, financial loss, customer grievances following late deliveries or batch inconsistencies, the safety of production personnel and even the safety of manufactured products – go far beyond the perceived threats in everyday personal computing and online banking.

Standards

Cyber security standards have been in force for decades to protect medical records credit and debit card dealings and the information that organisations, in general, hold about us (ISO27001). The industrial automation industry has not exactly been sitting on its hands either. The International Society of Automation's ISA99 committee has been working to define security standards for industrial automation and control systems since 2007. In 2010, these standards were aligned with the corresponding International Electrotechnical Commission (IEC) standards to become the ISA/IEC 62443 series – currently the most comprehensive set of standards dedicated to the security of industrial control and automation systems.

These standards have yet to be fully assimilated industry-wide. Meanwhile, responsible automation suppliers have not been tardy in developing innovative solutions to the problems of cyber-physical production system security, and have addressed the issues in a variety of ways.

For a decade or more, it has been possible to connect remotely to a PLC via a serial bus for monitoring and diagnostic purposes. Today's machine controllers are equipped with Ethernet ports that, for example, provide internet connection via the enterprise IT system to a remote, cloud-based SQL database in order to download stored recipe data.

Critical considerations

However, any vulnerability in that connection could potentially lead to compromised intellectual property relating to that recipe. The security of such open systems – and, by inference, the necessary level of co-operation that will be required between information technology (IT) and operational technology (OT) departments – have become critical considerations.

Omron's approach to the problem is to provide basic security for its factory automation systems using http Port

80 – the default port number for a web server – which protects Sysmac machine controllers by allowing communication only from within the Sysmac Studio configuration, programming, simulation, and monitoring software environment. Communication between the machine controllers and Sysmac Studio is not encrypted; instead, it is protected via digest authentication – a method that enables a web server to check a user's credentials, such as their username and/or password, with their web browser. The identity of a user can be confirmed before information is released to the network by applying a hash function to the username and password before transmission. Moreover, Sysmac controllers cannot send service data object (SDO) messages to the control network from external sources, so it is essentially isolated from the information network.

Advanced functions to protect investment in, and the security of, machines are standard in the Sysmac Studio software. Preventing incorrect connections, unauthorised operation or theft of assets are protected by features such as confirmation of controller names and serial IDs, administrator access rights and controller write protections. Meanwhile, authentication of user program execution and password protection for project files provide protection for the user's intellectual property.

Barriers that have traditionally existed between IT and OT departments will have to come down if a true Industry 4.0 implementation is to be realised. IT departments have, for many years, been fully aware of cyber threats and the potential damage that can ensue if systems are not adequately protected. For OT engineers, however, attacks on their systems are a relatively recent phenomenon and the threats and risks may or may not yet be fully understood.

Even today, the IT and OT functions remain generally independent of one another and it is normally the IT department that has any control over the prevention of cyber attacks on the enterprise by restricting access to the enterprise networks. Within the concepts of Industry 4.0 restricting access to the enterprise networks would be unacceptable, so it is important that IT and OT departments start to work together to combat the greater risks posed by the open networks of Industry 4.0.

Such a collaboration would also go a long way to improving the skills of those less familiar with cyber security and its relevance to their operations.

Manufacturers embracing the Industry 4.0 paradigm need to up-skill their operational staff, assess the potential cyber threat risks and develop a security plan commensurate with their organisational structures.

Barry Graham is automation product marketing manager at Omron.

Regulation compliance as a cyber security strategy tool

A recently published white paper describes some of the most effective industrial security tools pharmaceutical companies have at their disposal in the era of Industry 4.0. *Control Engineering Europe* reports.

To tackle increasing cyber security threats companies need to put cyber security at the very heart of the business. This does now appear to be happening and, according to the Global State of Information Security Survey 2016, respondents increased their information security budgets by 24% within the past year, reflecting a greater willingness to invest in keeping facilities secure.

The pharmaceutical industry is a particularly attractive target for cyber attacks, so pharmaceutical companies need to assess weak points and implement appropriate security measures. Bitsight, an organisation that measures how vulnerable companies and industries are to cyber attacks, reported that cyber security attacks on the healthcare and pharmaceutical industries have worsened at a faster rate than other industry sectors. With the average 'clean up' time for these sectors following a cyber attack being just over five days.

Pharmaceutical production control systems used to be proprietary and limited to the individual research and production facility. A typical industrial control system would not be directly connected to the Internet. However, an increasing need for automation and robotics, remote access and factory-wide connectivity has changed production and control systems significantly in recent years.

The introduction of the Industrial Internet of Things (IIoT) is the next major step towards a fully connected smart factory. The benefits of the IIoT-enabled pharmaceutical production facility are clear. Collecting and strategically interpreting production data using analytics and turning this information into insight can enhance productivity and help reduce errors.

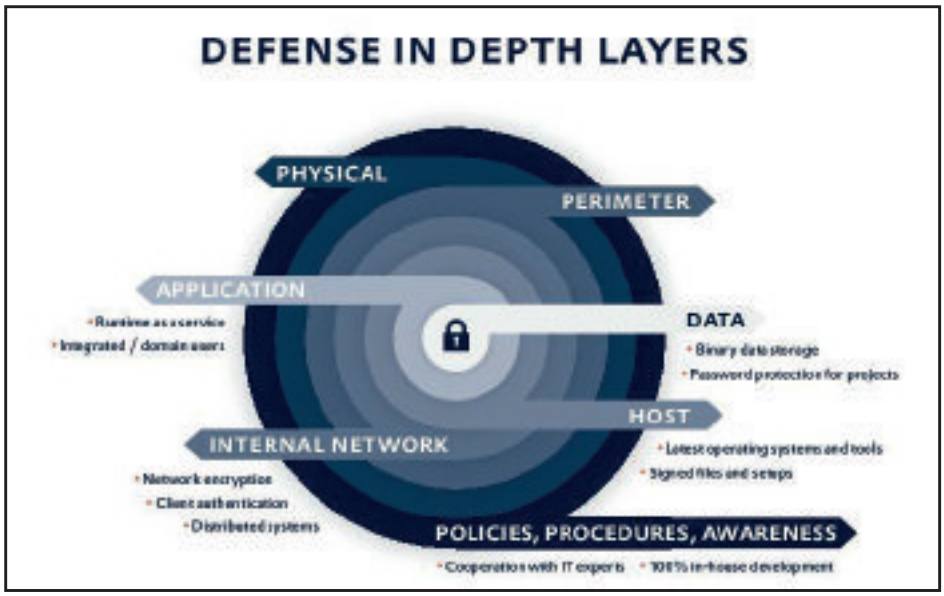
Protection through compliance

Operating in one of the world's most heavily regulated industries, pharmaceutical companies need to abide by a variety of complex laws, regulations and guidelines. Sometimes, these can become the basis for an effective industrial security strategy.

The Food and Drug Administration (FDA) 21 CFR Part 11 is one of the most established regulations within the industry. It requires organisations to implement controls, electronic audit trails and systems validations and establishes standard expectations for industrial security through the use of reliable electronic documentation of the manufacturing process.

There were initial concerns that FDA 21 CFR Part 11 may discourage innovation and technological advances. However, compliance is not just about ticking boxes. For the most part, its requirements go hand in hand with the security necessities of todays manufacturing facilities.

By reviewing historical documentation and records, organisations are able to detect where security breaches have occurred and in turn, identify and better protect the more vulnerable points in the system. This way, engineering and manufacturing data is protected against unauthorised access, modification or deletion to ensure accuracy, consistency,



and completeness. So, ultimately, successful FDA 21 CFR Part 11 compliance will also result in a more organised, efficient and secure production process.

Put simply, Electronic Records provide secure data. Authenticated electronic signatures ensure that operators and supervisors identify themselves in a safe and secure way when making any changes in the production process.

Combined with the implementation of smart machines and the resulting influx of big data, achieving regulatory compliance in the industry is not an easy task. To fulfil the requirements of these complex regulations and protect their facilities, smart pharmaceutical manufacturers are turning to validation-friendly applications and industrial software.

Smart SCADA security

Intelligent SCADA software, such as Zenon from Copa-Data, ensures that a HMI/SCADA system is compliant with industry regulations, and should provide built-in cyber security capabilities. Such a 'Security by Design' approach will mean that software and its components are designed to guarantee secure operations.

Built in software security features that protect companies against data loss and unauthorised access include a file signature functionality that recognises manipulated program files, strong encryption, secure authentication and automatic synchronisation of files in the network with 'click-and-forget technology'.

Integrated user administration, for example, ensures that unauthorised users cannot gain control of equipment. It means most user operations can be locked – even access to Windows Desktop. This way, if a security breach does occur, it can be easily contained and access to other applications can be prevented.

Best practice also dictates that pharmaceutical manufacturers should encrypt valuable data. This could mean compressing production data and sending it through the network and to web clients in an encrypted form, as well as ensuring passwords are encrypted to protect project data and expertise.

Some HMI/SCADA software uses its own network protocol to communicate between the individual software products. This allows data to be transferred to separate binary data packages and machine-readable information in plain text is never communicated in the complete communication concept. Further client authentication at the connection set up stage also prevents access to the network.

Potential attackers would then need to overcome a number of barriers before they get to the core of the production system. The overall strategy is topped off with open dialogue and documentation about security. A HMI/SCADA software provider should work closely with its customers to strengthen security guidelines and build on its industry experience.

Update and communicate

Knowledge and understanding of cyber security risks should not end with engineering and IT staff. According to respondents of the Global State of Information Security Survey 2016, the most cited source of security compromise lies with employees.

Internal security compromises may not be intentional, but could prove just as damaging as an external attack. For this reason organisations need to consider how much the average employee actually knows about keeping industrial systems secure. This could be as simple as encouraging staff to use strong passwords, deleting unwarranted e-mails and updating computers regularly. These basic measures go beyond the IT and engineering departments and should include other departments; even senior management.

After a thorough assessment of the system's potential vulnerabilities, creating a procedure and then training members of staff on industrial security should be the next step. Larger organisations might find it helpful to appoint a Chief Information Security Officer to manage industrial security issues and communicate the importance of cyber security, helping to create an engaged workforce and a company culture built on safety and security.

Industrial technology is evolving at an incredible rate. While upcoming trends such as cloud computing, IIoT and big data are certainly beneficial for the manufacturing industry, they also generate entirely new challenges for those managing the industrial security and data protection of organisations. While the days of Stuxnet may be behind us, manufacturers do need to stay ahead of the industrial security game if they want to avoid security breaches and the negative consequences they entail.

Making the right connections

Julian Anton offers advice for those comparing their options for lead screw motor connections.

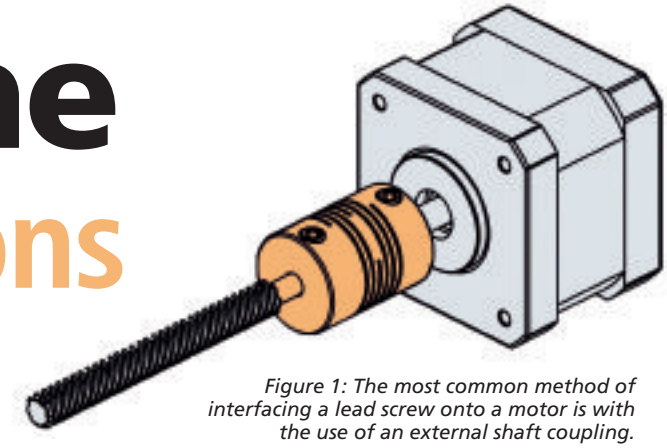


Figure 1: The most common method of interfacing a lead screw onto a motor is with the use of an external shaft coupling.

One of the most common mistakes a design engineer can make when selecting motors for lead screw applications is assuming that the way in which the motor and the screw are integrated does not matter. A properly integrated lead screw and motor can reduce costs, boost performance, simplify maintenance and provide greater prototyping flexibility.

Three of the most common approaches include implementing an external shaft coupling; permanently or semi-permanently fusing the lead screw and the motor shaft together; and using detachable connections.

External shaft coupling connections

An external shaft coupling is the most common method for interfacing a lead screw and motor. As illustrated in Figure 1, this is a simple cylinder, which receives the motor shaft on one end and the lead screw on the other. It is relatively cost effective and can be disassembled for service. There are also distinct disadvantages – reduced stroke length being the primary one.

In the generic 3-D printer configuration shown in Figure 2, the external shaft couplings limit stroke length on both the vertical and horizontal axes, which ultimately decreases the overall volume of what the printer can produce within a given footprint. Other disadvantages of using an external shaft coupling include the need for additional external bearings near the coupling to account for radial and axial support, further reducing available stroke length; increased overall system inertia resulting in a higher motor torque requirement; increased system complexity due to the additional fasteners, bearings and supports required; and increased system weight due to a higher number of components.

Permanent connections

Directly joining the lead screw to the motor shaft can be a low-cost solution, based on individual component costs. Some manufacturers do this by building a motor in which the lead screw is at the end of the shaft. Others will machine features onto one end of the lead screw and mount directly onto the motor shaft or conversely, they might mount a modified lead screw into a hollow shaft motor. The option of replacing the motor shaft with a lead screw can be cost effective but requires complex assembly, which must be done at a motor manufacturing facility. This method of integration also can be quite permanent. If there is an issue with either the lead screw or motor, the entire unit may need to be replaced.

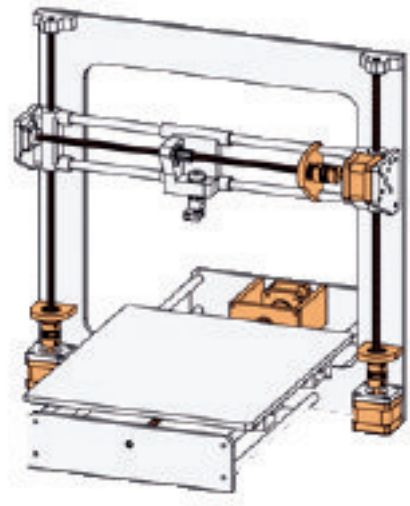


Figure 2: Couplings on vertical and horizontal axes limit stroke length.

Mounting a counter-bored lead screw onto a standard motor shaft, can be an inexpensive coupling method. Typically a machined knurl, adhesive and/or a cross-axial pin are used to further restrain the lead screw to the motor and limit the risk of detachment. Although this can provide an additional layer of protection, it complicates the assembly and permanently fixes the lead screw to the motor. This type of integration requires custom machining and high-precision assembly to prevent misalignment during mounting. Improper motor and lead screw alignment may introduce unwanted system vibration and potentially decrease motor performance.

Another common method for fixing a lead screw to a motor is inserting a modified lead screw into the hollow shaft of a custom motor. With this method, manufacturers will machine a journal to the end of a lead screw and insert it directly into

the mating shaft. Although this type of assembly can yield more stroke length over other direct connect options, it still requires precision machining, is difficult to assemble and can increase the risk of lead screw misalignment during assembly. This approach makes it difficult to replace the lead screw and to perform subsequent maintenance as needed since the lead screw is usually welded into place to prevent detachment. Also, during the delicate assembly process, manufacturers run the risk of damaging components within the motor.

Like the other permanently connected methods, this type of assembly also comes as a complete unit that would need to be replaced entirely if there are any individual component failures of the lead screw or motor. This can be a critical disadvantage at testing and prototyping when component flexibility can reduce costs and avoid delays in production schedules.

Detachable connections

Another connection option is a hybrid solution with a rapid-decoupling taper lock. This enables easy interchange of the motor or lead screw should one component need to be swapped out.

When considering a system with detachable components, attention to motor and lead screw alignment is critical. Poor alignment causes undesirable lead screw wobble (run out) and introduces vibrations that reduce motor torque, generate excess heat and produce noise.

Alignment must be addressed at the design phase. The Thomson taper-lock design, for example, is designed to maintain perfect alignment by using a self-centering conical socket and tapered shaft arrangement similar to that of the Morse taper, which has served the machine tool industry for many years.

Detachable connections have many advantages over traditional, permanently fixed solutions. They can reduce assembly time, simplify machine design, enable quick and easy prototyping, and drastically shorten maintenance time and costs. In addition to these benefits, they have a smaller impact on inventory by stocking only components rather than the more costly, fully integrated assemblies on hand.

The taper-lock solution also removes the need for external couplings and support bearings, which will maximise stroke length while still having a self-aligning, interchangeable lead screw that is easy to assemble and maintain.

A detachable connection is especially valuable in application environments subject to heat, contamination or corrosion; or where an unprotected lead screw is likely to require more frequent replacement. A single motor can support multiple screw sizes, simplifying both prototyping and inventory management.

Design engineers will have numerous integrated motor and lead screw assembly options. External shaft couplings can deliver acceptable thrust economy and some degree of maintainability but provide a limited stroke length and an increased overall footprint.

Joining the motor shaft and lead screw in more or less permanent arrangements can protect stroke length, deliver adequate thrust and offer some cost advantages. This approach can introduce lead screw run out and make it difficult, if not impossible, to change out lead screws during maintenance or prototyping. An architecture that supports interchangeable lead screws, self-alignment, maximum stroke length, application flexibility and cost-effective maintenance has the obvious advantage.

Answering the following questions can help you decide which option is right for you:

- Would any of your applications benefit from more stroke length?
- How often does the first prototype prove to meet your requirements?
- How often have you had to discard a complete motor and lead screw assembly when either the motor, lead screw or nut fails?
- How long does it take to replace a failed assembly?
- How often do your maintenance teams have to make a second or third trip to the field once the need for a replacement is identified?
- How often have you had problems with run out or noise?
- How much motor- and lead screw-related inventory do you maintain?

Your answers to these questions will help you decide whether your motorised lead screw needs are best served by external shafts or permanent, semi-permanent or detachable motorised lead screw components. The right choice can help lower the cost of ownership, increase performance, simplify maintenance and provide greater flexibility of product design.

Julian Anton is design engineer – Lead Screws at Thomson Industries Inc.

Thomson's Taper-Lock design.

FOUR WAYS TO IMPROVE midstream process optimisation

Boost output and use fewer resources while increasing plant life and performance.

The prevailing oil price slump has left everyone shaken, be it independent shale producers with a few rigs in their backyards or oil and gas giants who have dominated the market for years. The one thing that many have come to appreciate is the potential value of optimisation.

When selling prices get close to operating costs, any effort to shave off an extra dollar is rewarded. While this is true for the upstream, there is a lot of incentive for midstream and downstream facilities to follow suit. Process optimisation is one of the least capital-intensive methods of improving margins and is ideal for prolonged slumps where stakeholders and managers rarely see eye to eye.

Maintenance of critical components like control valves can go a long way in ensuring process optimisation and uptime. Courtesy: Intech Process Automation

What is process optimisation?

Process optimisation is a systematic improvement to all aspects of an operational process in order to improve output, utilise fewer resources and increase plant life and performance. Its implementation can vary from the slightest changes in inlet temperature, operating temperature or reagent concentrations to redesigning entire processes to improve utilisation and yields.

There are four main areas where midstream process optimisation can be implemented:

1. The initial process
2. Process parameters and operating constraints
3. Equipment, instruments, and devices associated with the process
4. Personnel tasked with oversight/ operation of the process.

Optimise the initial process

Optimisation encompasses redesigning or revising the process to uncover hidden efficiencies or rectify design inefficiencies. While most modern plants and facilities are extremely unlikely to have design inefficiencies, sometimes factors like changes in demand and expansion can render the original process inefficient. For example, a compressor station operating at peak efficiency with three compressors found maintenance costs increased when gas demand was significantly lowered. The operator redesigned how often each compressor worked to improve uptime under a lower load, reducing maintenance costs.

In another example, managers at a gas plant reused excess flare gas by redirecting it to generator sets that powered the plant's residential units. Electricity overhead was reduced while increasing the efficient use of flare gas.

Optimise process parameters and constraints

Operators at aging facilities can feel overwhelmed with alarms. As a plant ages, its instruments lose accuracy, control valves and rotating equipment wear out, pipes corrode, and electronics start failing. Optimising process parameters and constraints covers analysing the process with respect to its plant's condition and revising its parameters to make the best use of what the plant has to offer. Managing equipment load and times, adjusting pressures, temperatures, and reassessing the amount of reagents go a long way in improving midstream

process output and reliability. A healthy alarm management system can reduce the load on operators and prevent unwanted process hindrances.

These activities are highly recommended for gas processing and liquid natural gas (LNG) plants. Similar results can be achieved with pipelines, compressor/pumping stations, tank farms, and valve stations. For example, if a particular gathering station has wetter gas than normal, applying corrosion and drag-reducing agents can prolong pipeline life. If the station also has a separator and/or sweetener, they will require revised parameters too.

Equipment, instruments, and devices used in the process

The equipment's age may also be an issue. Sensors lose sensitivity over time, control valves get rigid, and rotary equipment wears out. Tuning instruments and devices regularly contribute to greater process yield. Transmitters can be calibrated, and control valves can be inspected for damage and tuned for optimised proportional-integral-derivative (PID) values; other equipment should be duly tested and maintained as needed. These activities should be part of routine maintenance at any facility, so conducting smart, efficient maintenance can prolong uptime.

Optimise human interaction

Even the most sophisticated unmanned facilities require some level of human interaction for sustained operation. An operator who knows the entire process and all its intricacies is equipped to respond to anomalies and prevent serious damage if a situation arises. In addition to operator training, efficient alarm optimisation and aesthetic human-machine interface (HMI) designs can improve operator concentration and reduce overloading.

One of the most significant routine costs at any plant or facility is maintenance. Standard maintenance procedures require routine inspections, measurements, and recording data. While this method of maintenance is widely practiced, it often wastes time of the personnel checking perfectly functional equipment and unnecessarily extends planned maintenance time. The advent of highly accurate and precise digital sensors and the concept of digital oilfields have opened up a window of possibilities for optimising maintenance processes and reducing overheads.

Condition-based monitoring and maintenance (CBMM) is a relatively new domain with great potential for predictive maintenance. With large-scale data storage capabilities available to even the remotest stations, all it takes are a few analyses of equipment and instruments to determine which are close to failing and which do not require any maintenance–in effect reducing maintenance time and cost significantly. The failure trends of all devices also help design a predictive spares inventory, reducing warehousing costs and the time needed to get replacements for failed components.

Combining these capabilities with the Industrial Internet of Things (IIoT) and cloud storage allows greater access to this information, whether in a central facility or on mobile devices. This holistic view of all midstream assets and facilities, complete with health status and maintenance reports, can help managers be more responsive to operations while senior management can focus on productivity.

Most optimisation activities will be a mixture of the different areas of optimisation discussed above. What makes midstream process optimisation work is a well-experienced team of experts who can take care of minor details and provide adequate support and training where needed. It may seem like a daunting task for end users who don't have very experienced optimisation teams or the means to carry out these tasks themselves, but there are many system integrators and original equipment manufacturers (OEMs) who provide these services throughout the world.

Ahmed Habib, assistant manager marketing operations, Intech Process Automation; Jahangir Malik, process optimisation engineer at Intech Process Automation.

Well-trained operators and a distraction-free control rooms can ensure prolonged uptime of midstream facilities and prevent significant incidents. Courtesy: Intech Process Automation

NEW DNCB RANGE DIN RAIL MOUNTING ENCLOSURES FROM HYLEC- APL HAVE SNAP ON KITS FOR QUICK ASSEMBLY

Solid or open tops; customisable; suits electromechanical and electronic applications

October 2016 – Wellingborough, UK: Hylec-APL, the specialist supplier of electrical components and enclosures, has announced a new series of DIN Rail Mounting Enclosures. The DNCB Range features snap-on bases and terminal covers for quick, easy assembly and is suitable for electromechanical and electronic applications. For electronic applications, the DNCB Range is suitable for PCBs up to 1.6mm thick, with slots which hold up to three PCBs horizontally or between two and four vertically. There is an option for incorporating a screw-mounted heat sink. The range offers a choice of solid or vented open tops: solid tops can be either perforated or non-perforated; alternatively a slotted option is available. A major benefit offered by this robust, high-quality enclosure range is ease of assembly – snap-on terminal covers and snap-on bases save time. DNCB enclosures can be customised to suit individual requirements.

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More info - Enter Link code 124894

ARC ENERGY RESOURCES ANNOUNCES ACQUISITION OF CLG ENGINEERING

Gloucestershire-based Arc Energy Resources has acquired precision machining company CLG Engineering.
Commenting, group managing director Andrew Robinson, says: "This is a fantastic opportunity, with CLG Engineering's precision machining capability perfectly complementing our cladding and fabrication offering. I have great plans for future growth, and am looking forward to supporting our clients on new and larger projects."
The acquisition means that Arc Energy Resources' 80 employees are supplemented by CLG Engineering's 14, to create a stronger team with a wider mix of skills. Both companies are supported by teams of experienced project managers, inspectors and welding engineers, with access to a wide range of auxiliary processes in-house, including heat treatment, NDT and CMM inspection.

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E-mail: sales@arcenergy.co.uk
Web: www.arcenergy.co.uk

More info - Enter Link code 124316

NEW FROM OMEGA 8 OR 16 CHANNEL UNIVERSAL INPUT TOUCH SCREEN DATA LOGGERS

The OM-DAQXL from Omega is a New 8 or 16 channel analogue input portable data logger with a 7 inch resistive touch-screen colour display. All inputs are programmable and can be configured for millivolts, volts, milliamps, thermocouple, RTD, thermistor strain gauge or frequency. All the menus, selections and configurations can be accessed from the display touch screen. The unit also has a 4 digital inputs 4 digital outputs, 4 alarm outputs, one USB host port and one USB device port. The unit also has 3 LED's for different indications (power, alarm and logging).

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Sales Fax +44 (0)161 777 6622
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More info - Enter Link code 124893

USB232 FROM KK SYSTEMS

The USB232 from KK Systems is an industrial-grade UK manufactured 1.5kV-test isolated USB to RS232 converter which supports baud rates to 230k.
Drivers are included to create a virtual COM port within the operating system which is compatible with every normal Windows application program.
The USB232 is unique in the market in that it has a world-unique device ID which ensures that it appears under the same COM port regardless of which USB port on a particular PC it is plugged into.
This simplifies application software configuration and avoids customer support issues caused by a converter being moved to a different USB port on the same computer.
Unlike many other converters, all RS232 signals are supported for total compatibility.
The USB-232 is completely plug-and-play and no configuration is involved outside the application software which uses the COM port.

For information from KK Systems Ltd
Tel 0044 1273 857185
Fax 0044 1273 857186
Web www.kksystems.com

More info - Enter Link code 124314

MEASURE THE SMALLEST AND THE TALLEST WITH ONE DEVICE

Revolutionary technology for level and volume measurement in the food and beverage industry

VEGA introduces the first contactless radar level sensor for liquids that operates at a 80 GHz frequency. Contactless radar technology is known for its immunity to temperature, pressure, vapours or surface conditions, but previous devices had larger antennas and restricted measuring capability. With a new, amazingly small antenna system, the VEGAPULS 64 is ideal for use in small vessels with small process connections, often seen in the food industry. However, there is also long range capability with narrow focussing too, enabling it to work even in very tall, narrow vessels for liquids (there is also a model designed for bulk solids for grain and powder level measurement). Hygienic materials and process connections also offer excellent process compatibility.

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Aiming for flexible FINANCE MODELS

OEMs are leading the way in the manufacturing supply chain with asset finance, says *Brian Foster*, head of Industry Finance at Siemens Financial Services in the UK.

Manufacturers are reporting a growing need for investment in new-generation technology to enable them to capitalise on the benefits and counter the challenges of Industry 4.0. This is good news for OEMs, as rising demand at any point along the supply chain can provide opportunities for higher sales and profit.

Investment in new-generation production technology is important for manufacturers. A recent Siemens survey of a large majority of manufacturing businesses in the UK, for example, found that 83% said they had made investments in the automation of production processes in the past five years.

Financial considerations were often cited as the reason where such investments have been deferred. More than half (54%) of manufacturers who have not automated in the past 12 months fear that the return on investment period of the new equipment would be too long. Similarly, Hennik Research, Annual Manufacturing Report 2016 found that just under one-third lack the necessary investment budget and are concerned about ongoing costs.

Additionally, according to the Royal Academy of Engineering businesses in the UK still perceive bank lending conditions to be restrictive and bank loans are not seen as a suitable source of finance. Manufacturers are therefore increasingly looking to diversify their funding options and gain access to flexible and transparent finance.

Asset finance solutions, such as leasing and rental-based options, have a number of advantages over conventional loans. These financing arrangements offer the option to spread the costs of the equipment over a pre-agreed period removing the need for large upfront payment. As the finance facility is secured wholly or largely on the asset being financed, the need for additional collateral is reduced. The lease cannot be recalled during the life of the agreement which provides increased peace of mind for the user. Additionally, asset finance offers flexibility because businesses have the option to add on, replace or update equipment during or at the end of the lease period. OEMs engaged in the manufacture of machinery could also leverage these benefits to drive sales by integrating asset finance into their overall offering.

A flexible programme

An example of a flexible vendor finance programme is the arrangement between machine manufacturer TRAKRAP and Siemens Financial Services (SFS). The producer of energy efficient packaging solutions for the retail sector developed a patented wrapping system that uses 90% less energy and 70% less wrapping film than traditional shrink wrapping by removing the requirement for heat tunnels. As demand for the solution was growing the company wanted to access a suitable form of finance that would help its cash flow and improve its customer proposition by providing clients with an attractive financing solution. The manufacturer was introduced to SFS by its technology partner Siemens Digital Factory. SFS was able to offer a forward-thinking vendor financing solution. Under the agreement SFS pays TRAKRAP for the equipment and leases it to the end customer, enabling costs for the use of the system to be spread over the contractual period on a 'pay per wrap' basis. The lease costs are offset by the savings made through the use of the equipment.

This allows TRAKRAP to discuss financing with its clients right from the start. The 'cost per use' lease has proven an important sales tool as TRAKRAP can now offer its wrapping technology to a much broader customer base. The 'cost per wrap' arrangement allows for a reliable assessment of expected savings for the end client and delivers a strong business case for the investment. Without the need to buy and own the equipment the customer benefits from the use of the system without a large upfront capital expenditure. Additionally, TRAKRAP receives the payment for the machine at the outset of the lease, so can continue to grow its business.

Working together with specialist financiers can help OEMs offer the added convenience of a viable financing solution while focussing on their core business of providing advanced technology solutions. In this way, they can set their products and services apart from the competition, give their clients a compelling reason to buy, and enable them to buy today instead of delaying their purchase.

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