



 PEPPERL+FUCHS

News for
Factory
Automation

1/2016

Following the Call of the Future

Sensorik4.0® is a pioneer of the fourth industrial revolution

Across All Boundaries

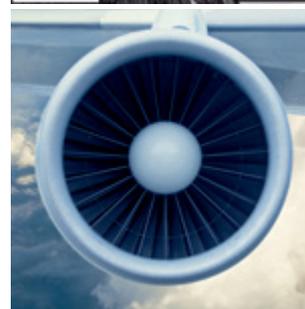
OPC UA is a standardized protocol for the smart factory

04

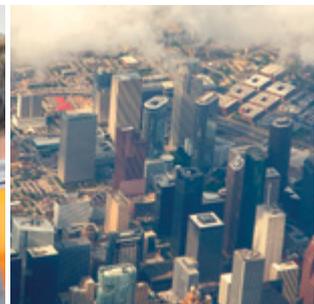


APPLICATIONS + KNOWLEDGE

- 12 Compact Load Carrier**
Safely underway on a circular path
- 14 Message in a Bottle**
How sensors make the world a little bit greener
- 16 Master of the Air**
Flying safely with fully automated crack detection



18



twitter.com/PepperlFuchs
Follow us on Twitter, where you will find news and useful links from the field of automation technology.



youtube.com/PepperlFuchsGmbH
Subscribe to our YouTube channel, where videos featuring interviews, background knowledge on technologies, and tutorials are regularly added.

TECHNOLOGIES + PRODUCTS

- 04 Focus:**
Following the Call of the Future
Sensorik4.0® is a pioneer
- 08 Identical on the Outside**
The next generation of photoelectric sensors
- 10 Small Module for Great Safety**
Combining position and speed monitoring



MARKETS + TRENDS

- 18 Across All Boundaries**
Standardized protocol for the smart factory
- 22 Welcome to America**
Among friends in cool cities
- 26 Always Hungry**
A new home for Oz



Dear Reader,

Having a partner at your side helps when it comes to brainstorming ideas, improving existing processes, and continuing to grow together. After all, exchanging thoughts with someone at eye level enhances your ability to see things from another's perspective and in turn develop yourself – not only privately but professionally as well. With this in mind, our company maintains numerous close partnerships to ensure that our products meet market demands. This helps us drive innovations and meet customer needs in the most effective way, anywhere in the world.

The collaboration initiative based on trust between our company and the collection system manufacturer TOMRA started over 15 years ago with a Norwegian shop owner who wanted an efficient way of collecting bottles. Together, we are treading an environmentally friendly "green path" toward a sustainable future; after all, each and every reverse vending machine the company produces is equipped with sensor solutions from Pepperl+Fuchs.

With the AutoInspect research projects managed by Lufthansa Technik, the Pepperl+Fuchs subsidiary VMT (VMT Vision Machine Technic Bildverarbeitungssysteme) is researching fully automatic crack detection and evaluation for combustion chamber components – a further example of cooperation based on our shared commitment to continuous improvement. This exceptional joint project is helping to guarantee an outstanding level of safety in the air thanks to millimeter-precise work on the ground.

I hope this issue provides you with some exciting insights into the world of Pepperl+Fuchs – happy reading!

Dr. Gunther Kegel
CEO

We look forward to receiving your feedback on this issue.
Please e-mail any comments to: newsletter@pepperl-fuchs.com

Focus

Organs of perception for Industry 4.0

Paving the way for Industry 4.0 – this is how Pepperl+Fuchs understands Sensorik4.0®. But it is more than just a theory: The company has already tested practical applications in its own production plants as well as with other companies. For the future, one thing is crucial: cross-border, global thinking – and cooperation between automation, mechanical engineering, and IT.

Individual products that navigate themselves independently through production and have a role in determining their manufacturing route. Machines and workpieces that communicate with each other via the cloud. Transport systems weighing tons that guide themselves driverless through factory buildings. Such scenes are no longer the stuff of an author's vivid imagination, they are being tested in reality. The fourth industrial revolution keeps marching on and is changing companies worldwide. This is because companies find themselves facing new requirements and have to rethink their products, as well as their production processes, to prepare for the future.

"Today's sensors provide analog and digital measurements, which are used for monitoring and controlling as well as in closed-loop control circuits with high dynamic requirements. In contrast, the sensors of the fourth industrial revolution – Sensorik4.0® – will be one of the most important data sources for Industry 4.0 concepts," explains Dr. Gunther Kegel, CEO of Pepperl+Fuchs. It is important for globally operating enterprises that the Sensorik4.0® concept is tested in

practice. "Together with other companies, we are already testing practical implementations. But even within our own organization, we are not standing still: Ultimately, we must prepare our company for the future and can already benefit from networked production today," says Dr. Kegel.

Smart Factory – Smart Business – Smart Product

One example of a good first approach is the horizontally and vertically networked manufacturing process for the photoelectric R100, R101, and R103 series in the Pepperl+Fuchs plant in Berlin. Vertical networking, which means networking of various IT systems on different hierarchical levels inside a production plant – from the actuator and sensor level, to the process and production control layer, to the MES and the enterprise level – offers many advantages. "The fixed process flow is a thing of the past – today many different products are manufactured flexibly according to particular configuration rules," explains Hinrik Weber, Head of the Photoelectric Business Unit.



The company is also well connected along the value-added chain. "Optimized ordering, quality, and logistics processes are essential to enable us to act quickly and flexibly and supply our customers with high-quality products within a short period of time," explains Weber. "Horizontal networking is the keyword here. Large parts of it run within our ERP system – for example, in the supply lines of external and internal suppliers, but also in order taking or deliveries."

The product itself contributes to networking processes: An IO-Link interface is integrated in all R100, R101, and R103 series. IO-Link enables communication all the way down to the sensor level – the basis for Sensorik4.0®. In the future, the small photoelectric sensors can be a networked participant in an Industry 4.0 production plant. (Read more on page 8.)

Limit Value Exceeded: Information via E-mail

Another example of the use of future-oriented solutions in production is provided by the pearl powder filling machine, whose fill level will, in

the future, be monitored in the cloud. The machine fills housings, such as monitors of human-machine interfaces, with small glass pearls to isolate the electrical components for explosion protection (protection type q). "Using an ultrasonic sensor, we can measure the fill level in the system and therefore know when new glass pearls need to be added," says Benedict Rauscher, Development Group Manager at Pepperl+Fuchs. "The special feature here is that we want to connect the sensor to the cloud via IO-Link using SmartBridge® technology." SmartBridge® technology is based on an IO-Link master that can either communicate directly with the sensor or log an existing IO-Link connection between a master and the sensor in transparent mode. SmartBridge® allows data to be transferred securely and seamlessly to the cloud. Pepperl+Fuchs is working together with the start-up connectavo, which offers a cloud solution for industrial sensor data. Using the cloud-based portal, additional limit values can be set, in this case a particular fill level. In the example of the pearl powder filling machine, the designated employee receives an e-mail when the limit value is exceeded. »



» “This tells us when the system needs to be refilled, saving us unnecessary checking processes and storage costs,” explains Rauscher. This simple example is just one possible use of intelligent networking. In the future, intelligent sensors and cloud-based databases will monitor complex processes and allow simple access, irrespective of their location.

**Cooperation Based on Partnership,
Results Relevant to Practice**

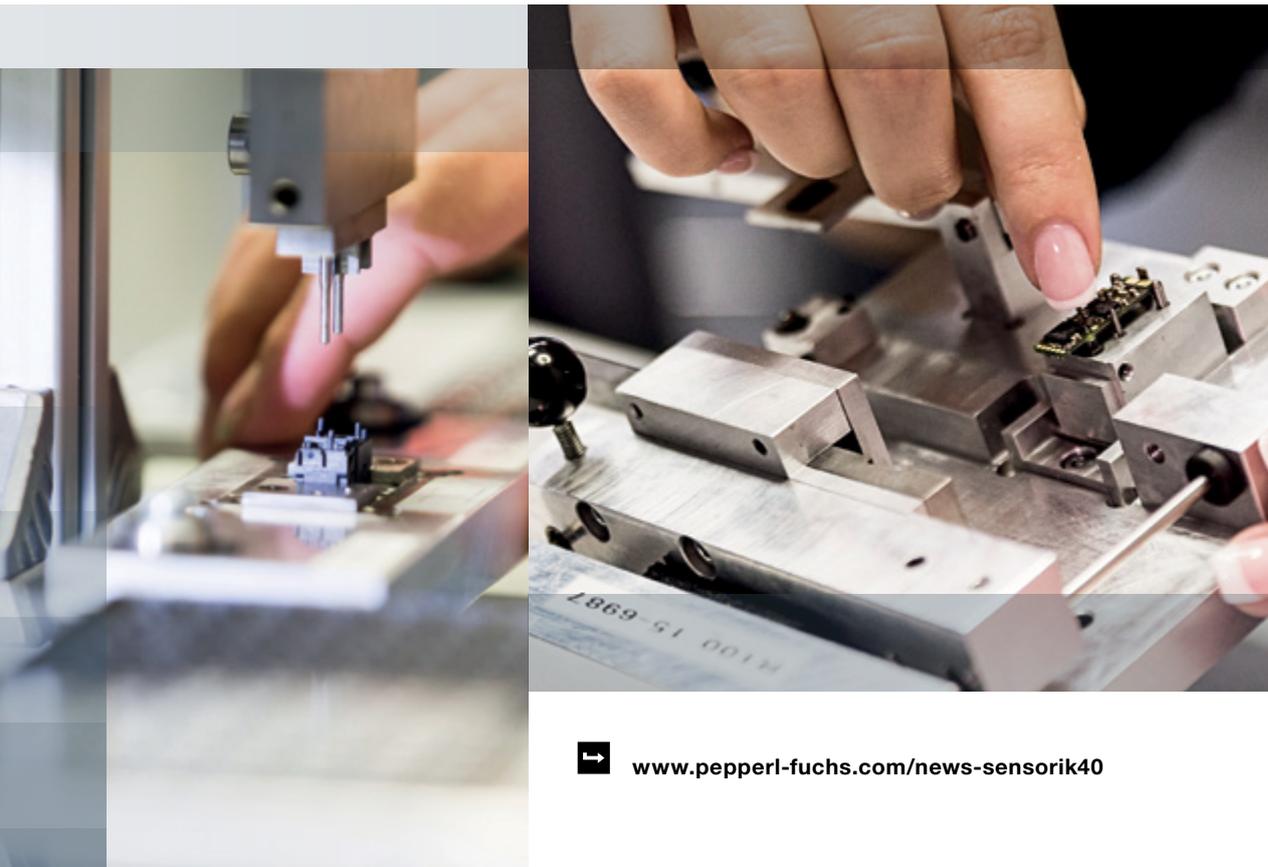
For the economy and industry, one of the main advantages of the Industry 4.0 approach is the possible increased process effectiveness: Continuous communication and data availability from the field level to the control level are key to making existing production lines and processes more effective. “In cooperation with Software AG and the connection specialists TE Connectivity, we use a demo model to show that with even a small amount of data from the production process and intelligent data analysis, considerable added value can be created for production,” says Michael Bozek, from Product & Business Development Management for Industry 4.0.

A scenario was developed to reflect a familiar situation on production lines: The shop floor, the lowest level of the demo model, shows two

manufacturing processes, “stamping” and “pressing,” which transfer their pre-products to the downstream “assembly” target process with precision timing. Preliminary and target processes must be both synchronized and operated simultaneously for maximum productivity. “Normally, a manufacturing execution system (MES) takes on this task. With the demo model, we show that only a small amount of specific data from the shop floor is required to optimize the system,” explains Bozek.

**Process Optimization,
Status Monitoring and Service-on-Demand**

Three value-adding starting points for new Industry 4.0 concepts are process optimization, status monitoring, and service-on-demand. By replacing or retrofitting fewer hardware components and using a business platform supplied by Software AG, this can be enabled for existing machines and systems. At the sensor level, performance-critical process data is transferred wirelessly from the sensor to the business platform using a SmartBridge® interface and an appropriate gateway as a counterpart. At the control level, TE Connectivity’s SPARK interface taps wired data from the fieldbus. “The business



www.pepperl-fuchs.com/news-sensorik40

platform consolidates both data sources. With the help of downstream processing, process parameter deviations can already be detected by using a simple comparison. This not only creates informative transparency throughout the production process but, at the same time, also identifies the points with the greatest potential for increased effectiveness,” explains Bozek. “In this way, we can detect delays or micro-downtimes that are not so obvious and optimize the preliminary processes and target processes, taking into consideration the order situation and current stock levels.”

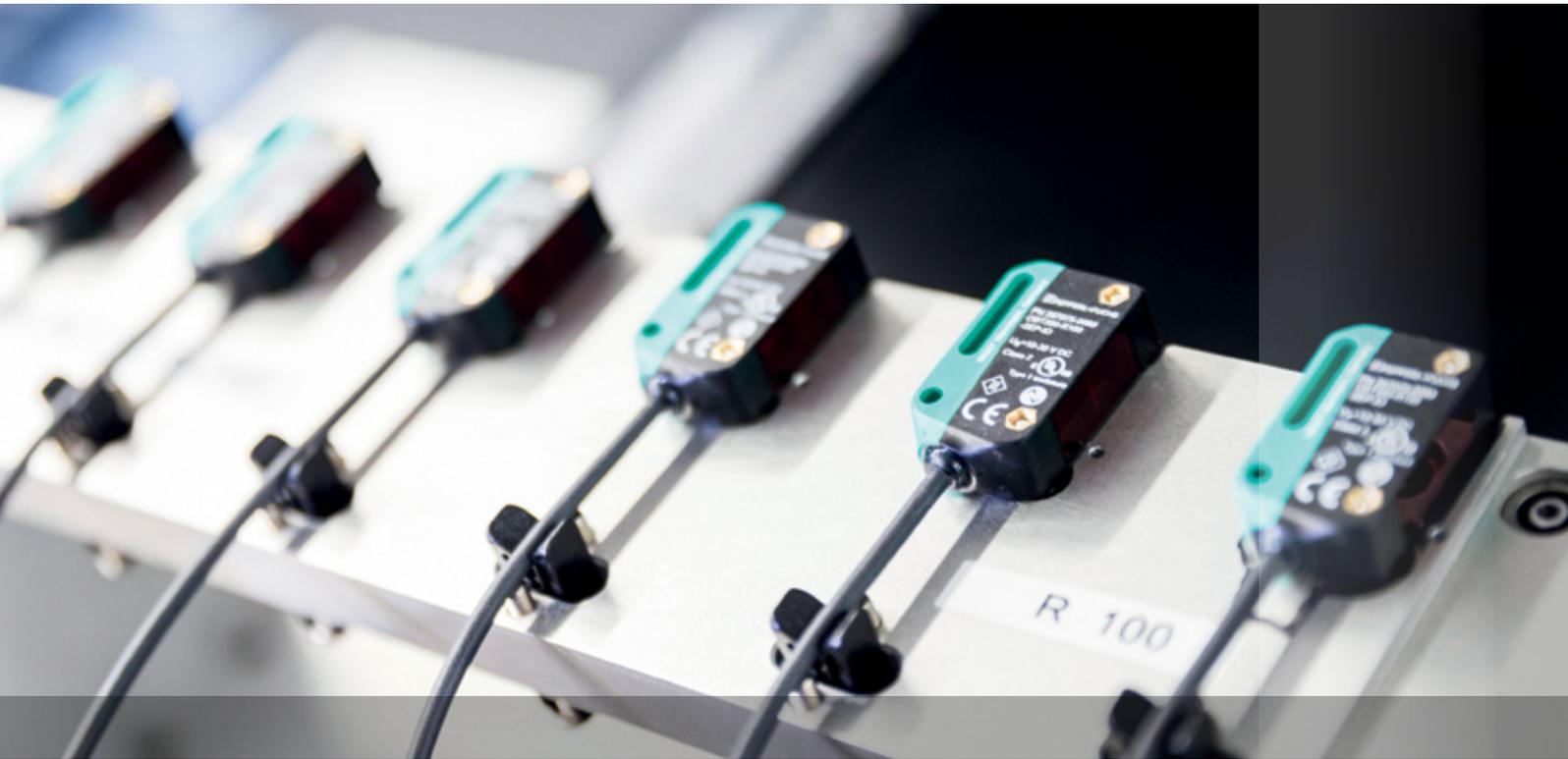
The Path to the Networked Future Starts Today

The aggregated data is essential to improve the availability of machines and systems. “The recorded notes and warnings from the sensors allow you to determine the current status of not only the component itself, but often even the machine or plant. Historical values that correlate with the actual machine runtimes and maintenance recommendations of the manufacturer provide an excellent picture of the current status of the machine or plant. This helps detect impending failures at an early stage and reduces downtime,” explains Bozek. “Even today, industrial components provide information on contami-

nation or wear, but in practice they are rarely used. There is a large amount of untapped potential: With the help of SmartBridge®, this data can be extracted by smart sensors and transferred wirelessly to a service platform via an Internet gateway. There this status data is evaluated and, if necessary, a service contract can be triggered in the company’s maintenance department or with an external service provider,” explains Bozek. “Our demo model thus impressively illustrates how easily and efficiently future production processes can be optimized.”

These examples show that continuous communication from the field level to the IT level is essential to ensure that intelligent sensors are used to their full potential. Cost-intensive modifications of machines and plants are not always necessary to achieve this – sometimes an investment in a few additional components is sufficient to make production processes economical and to optimize them in line with the concept behind Industry 4.0. Comprehensive, barrier-free communication in automation is not merely a vision anymore – we have already taken the first few steps along the path towards it. ■

Photoelectric Sensors: The Next Generation



Photoelectric sensors The new generation of small photoelectric sensors continues to grow: Like the R100 and R101 before it, the R103 packs an entire family of sensing modes into a single, standard housing.

From the thru-beam sensor to sensors with multiple switch points and distance sensors, the R103 integrates the whole portfolio of photoelectric sensing modes in a standard design. "In addition to our Multi Pixel Technology for precise object detection, DuraBeam, a unique laser technology, is also particularly worthy of mention. It combines the advantages of LED and laser sensors," explains Sebastian Pesch, Product Manager for Photoelectric Sensors.

This is because DuraBeam enables use at temperatures from $-40\text{ }^{\circ}\text{C}$ to $+60\text{ }^{\circ}\text{C}$ and impresses with robustness and a particularly long service life. In addition, all sensor variants have an IO-Link interface that enables continuous communication down to the sensor level – the basis for Sensorik4.0®. The SmartBridge® technology can also be easily integrated via IO-Link. Sensor data can thus be conveniently accessed via a mobile screen and the sensors can be parameterized.

"As with the first two representatives of this new generation of photoelectric sensors, R100 and R101, the R103 also offers a future-oriented product architecture: An integrated design and installation concept for different applications – and therefore maximum flexibility and cost savings," explains Holger Unger, Product Manager for Photoelectric Sensors. Regardless of the functional principle, all series have a wide range of connection options, making them very versatile.

Users benefit from a uniform operating concept. The multiturn potentiometer and the push buttons allow the quick parameterization of all functions; the display of sensor states is also uniform across all series. This saves time, reduces operating errors, and commissioning costs: "Once understood always understood, that is the motto here," says Pesch.

One Sensor – Multiple Switch Points

Thanks to their wide range of functions, the versatile R100, R101 and R103 series photoelectric sensors easily handle sensing tasks in a variety of industrial applications.



These switching sensors come with measurement core and combine multiple operating modes, such as window operation mode and switch points that can optionally be configured via IO-Link, in a single sensor. Just one sensor is able to detect different stack heights.

What does the application look like? Multiple automated conveyor routes are often installed in production plants. The conveyor belts transport products in containers such as boxes or trays. These products are removed from the containers for further processing in an automated process. The switching sensor with measurement core is installed above the conveyor belt and “looks” downwards into the containers. It detects the different stack heights of the products in the containers by means of a distance measurement. If these products are successively removed from the container, using a suction pad, for example, the sensor detects this using the two configured switch points. In this way, more products can be added even before the container has been completely emptied.

The advantage is obvious: Supply routes can be exploited more effectively. Where previously two sensors were needed, now one sensor is enough. “Efficiency in the application is increased; procurement and logistics costs are reduced. The sensor can optionally be configured via IO-Link and, thanks to its Multi Pixel Technology, offers a high degree of adaptability for different applications,” says Sebastian Pesch, Product Manager for Photoelectric Sensors. ■



www.pepperl-fuchs.com/news-r10x



Large **M**achines Monitored with a Compact System

AS-Interface The new KE4 module can safely monitor speed and position simultaneously. When this module is used in combination with the Safety Monitor, it is possible to implement decentralized solutions for a wide range of safety-related architectures.

Some of them can lift up to several hundred tons, weigh several tons themselves, and heave their loads to dizzying heights: It is clear that safely controlling these machines is particularly important in ensuring that people, materials, and the environment are not put at risk. That is why rotary encoders and speed modules are often used, for example, to limit the pivoting range of cranes.

“With the technology that was previously used, you had to decide if you wanted to monitor the position or the speed,” explains Dr. Konrad Kern, Product Manager for Systems at Pepperl+Fuchs. “The KE4 module enables position-dependent speed monitoring.” This technology offers the key advantage of being able to monitor both position and speed, not just for cranes but for other machine movements, too.

“Other potential applications include position and speed monitoring in driverless transport systems, speed monitoring in production lines, or in deceleration ramps for stacker cranes,” Kern continues. Even small, decentralized safety applications can be implemented in a cost-effective manner using the KE4 module, as in the case of rotary tables or stacker cranes. The KE4 module knows the end positions and permissible speeds, initiates timely braking, and ensures that the device safely comes to a standstill in the correct place.



Up to PL e and SIL 3

How exactly is the KE4 used? The module has two inputs for rotary encoders or linear measuring sensors that can be connected via a TTL, SSI, or sin/cos interface. Two safe outputs and numerous safety functions mean that the module can be used in safety-critical applications. With paired encoders or with one safe encoder per axis of rotation, the module satisfies the requirements of safety levels PL e and SIL 3.

Pepperl+Fuchs offers a wide range of different products and technologies that can be connected to the KE4 module for positioning tasks. These range from optical distance sensors such as the VDM100 – which uses Pulse Ranging Technology – to rotary encoders and even positioning via Data Matrix codes, as is done with the PCV, for example.

Clear Safety Logic

Not only is the KE4 module able to control and monitor individual machines and plant components; when used in combination with the Safety Monitor, it offers a compact solution and can do much more: “With the monitor, the user has the opportunity to monitor safe position ranges and speeds from a remote location,” explains Kern. Eight logical trip circuits offer a wide range of safety options. Safe position ranges and speeds are parameterized using PC software, and the configuration is stored on a memory card in the device. “This is a further advantage: components can be replaced quickly and easily, reparameterization is not required,” says Kern. “This means that the safety logic remains clear and decentralized even for larger and more complex applications. This often means that a higher-level PLC is not required.” The AS-Interface network enables flexible expansion of the compact safety system without being restricted to any particular topology. ■



www.pepperl-fuchs.com/news-as-interface



AS-Interface

AS-Interface replaces the conventional wiring technology on the sensor-actuator level. It has established itself as the standard for cost-effective signal transmission using the same cable for power and signals. Worldwide, there are 35 million installed AS-Interface I/O devices/modules in use, of which more than three million are safe I/O devices/modules. This makes AS-Interface the leader among safe field communication systems. Modules are always installed in the same manner, regardless of the controller and higher-level fieldbus system: The module is placed on the flat cable at any position and can be integrated in all common controllers. Machinery and plant manufacturers can completely decouple the installation from the higher-level controller, which is to be connected later on. This enables efficient production standards to be defined.

Autonomous and on Track

It is ready to use quickly, exceptionally lightweight, flexible, and can carry loads up two-thirds its own weight: The new “LEO Locative” automated guided vehicle from BITO will be launched onto the market in fall 2016. Sensors from Pepperl+Fuchs are being used to ensure the autonomous system always remains on track.



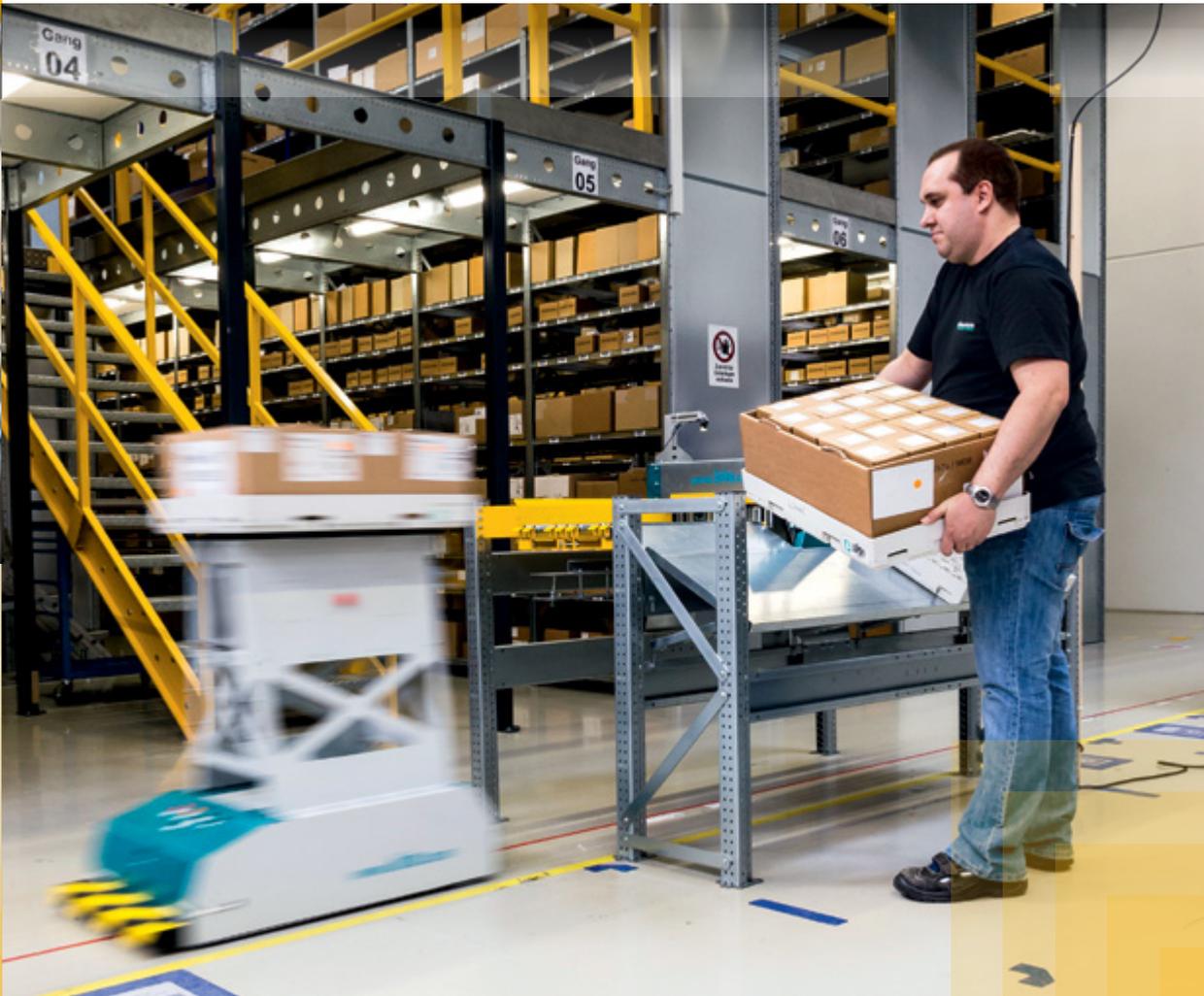
LEO reliably travels the rounds, as defined by the colored tape on the floor. At the designated stations, the autonomous transport system unloads containers and cartons weighing up to 20 kilograms and at the same time picks up new ones – all this when the unit itself weighs only 30 kilograms. During this process, it is vital that LEO does not veer off track and collisions are avoided.

Six sensors from Pepperl+Fuchs are used to ensure just that. The R2100 2-D laser scanner monitors the distance to the vehicles in front using Pulse Ranging Technology, providing reliable protection against collisions. The PGV100 positioning system also operates without making contact. It ensures that the transport system does not veer off track from the colored tape. The exact position is determined using Data Matrix codes. “This enables LEO to approach the stations in a targeted manner. However, it is also possible for the positioning system to bypass a transfer station if it is already occupied, for example.

In this case, LEO will visit the station during its next round,” says Hicham El Menaouar, Sales Engineer at Pepperl+Fuchs. The transport system is equipped with light sensors and thru-beam sensors that make it possible to check whether vehicles and transfer stations are occupied.

Travelling along the Circular Path

“Nowadays, automated guided vehicles are used in a whole host of areas,” says Dennis Ramers, Product Manager for Machines at BITO. “With LEO Locative, however, we have brought a completely new and unique system onto the market: It is cost-effective, easy to operate, extremely flexible, and weighs only around 50 kilograms when fully loaded.” The circular path along which the automated guided vehicle travels can easily be changed and adapted to suit local conditions at any time. LEO follows a visual path in the form of colored tape; this tape can simply be pasted onto the floor and removed again just as



quickly. "It is even possible to add new transfer stations or other transport systems at any time, allowing the user to respond to order peaks with a high level of flexibility. The systems can then be removed from the circuit again just as quickly," Ramers explains.

From Project into Practice

LEO came about as a result of a project commissioned by BITO – a specialist in storage and operating equipment – and undertaken by the Fraunhofer Institute for Material Flow and Logistics based in Dortmund. The focus of the project was on developing a cost-effective system that is also particularly flexible in its design and easy to use. "The issue of controlling this sophisticated application was resolved using our sensors – we have ultimately spent over three years collaborating on the project," says El Menaouar.

BITO has already successfully tested all the vehicles in the pilot run with its end clients. "We were delighted to test LEO in practice at our own plant in Buehl," says Markus Hertel, Site Manager for Pepperl+Fuchs at the plant in Buehl. The small, flexible system offers another key advantage: Due to its low weight and maximum speed of one meter per second, no special safety engineering is required. "This makes the flexible transport system particularly attractive for use in logistics," says Hertel. "LEO is proving reliable in operation on our test circuit in Buehl – we are happy that the collaboration with BITO has yielded such an excellent result." ■

 www.bitocom

Growing a Green Future



How a joint venture between the Norwegian reverse vending machine manufacturer, TOMRA, and the Mannheim-based automation company, Pepperl+Fuchs, is making the future greener.

Grabbing a bottle of water out of the fridge – an everyday scene. But what happens after the beverage packaging is empty? The journeys taken by packaging – be it glass, plastic, or tin – are many and varied. The bottles start at the production environment and continue to the filling room. From there, they move on to a central warehouse and into the stores. Once the bottles are empty, the consumers bring them back to a reverse vending machine. Who actually came up with the idea for such an ingenious return system?

From a Rural Shed to the Global Market

It is more than 40 years since a Norwegian shop owner in a suburb of Oslo expressed a desire for a machine that can collect empty bottles in a simple, efficient, and customer-friendly manner. This idea inspired the two brothers Petter and Tore Planke to develop a reverse vending machine.

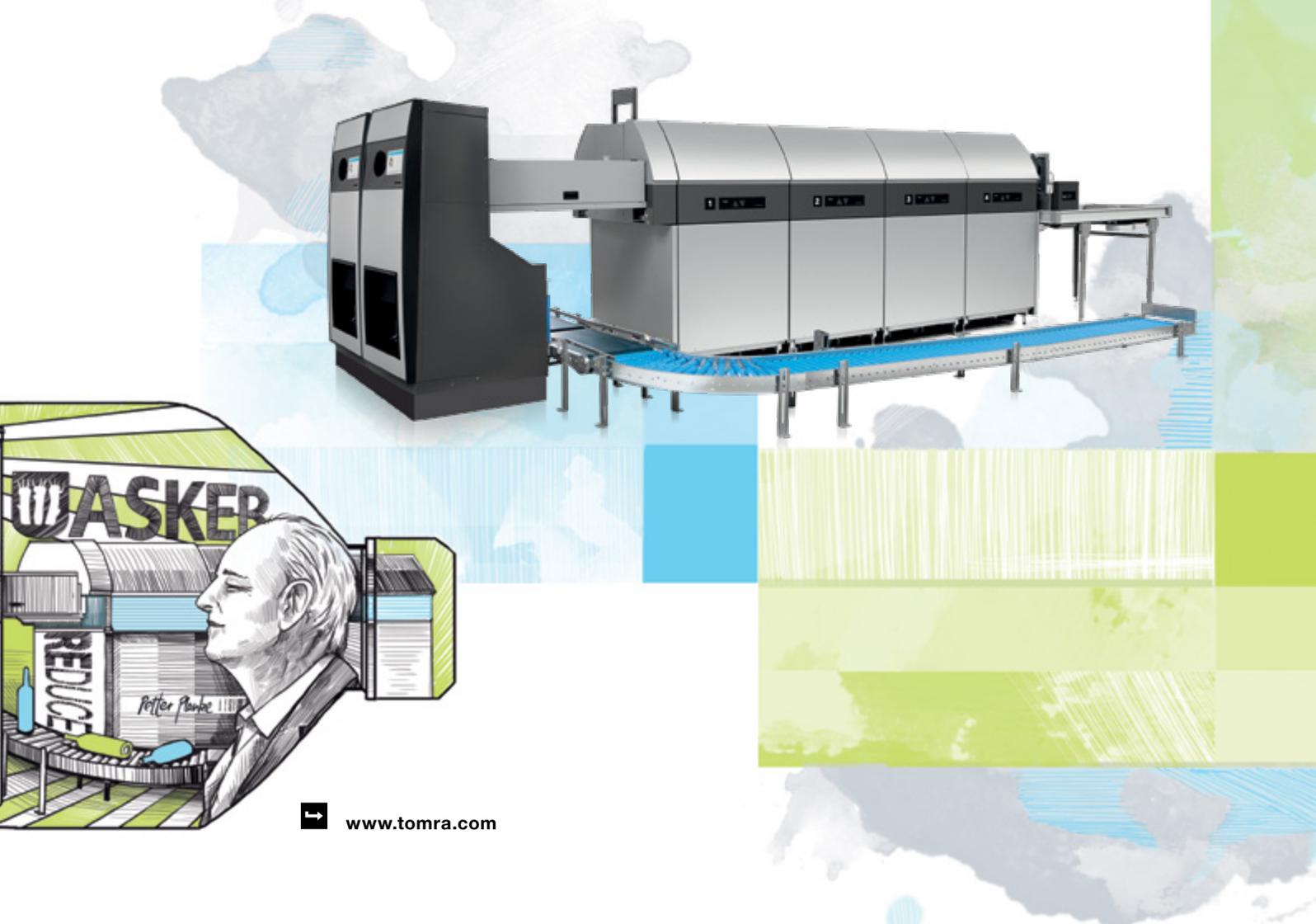
The industrial adventure of the Norwegian world market leader, TOMRA, started in a small shed in Asker, Norway. Today, reverse vending machines remain the company's most profitable business area. Thanks to organic growth and various strategic business acquisitions, TOMRA has become a leading global player in the field of recycling

and sorting technology for the mining and food industries. The Scandinavian company provides supermarkets in over 80 countries with sensor-based solutions for optimal resource productivity through reverse vending machines, collection systems, and sorting solutions that facilitate the effective reuse of drinks packaging. Posting an annual turnover of NOK 5 billion (approx. EUR 517 million) and employing a staff of over 2,500, TOMRA's sustainable recycling products are instrumental to guaranteeing a viable, greener future.

For more than 15 years, Tomra and Pepperl+Fuchs have pursued this "green path" together. Both the family business from Mannheim and the specialist in reverse vending machines, which is still based in Asker today, are driven by innovation.

A Little Piece of Pepperl+Fuchs in Every Reverse Vending Machine

While Tomra invented the bottle detection technology, each of its reverse vending machines uses sensor technology developed by the Mannheim-based automation company: in all aspects of the material handling, as well as the subsequent sorting solutions. "Pepperl+Fuchs is involved in detecting various types of packaging



 www.tomra.com

and sorts them into different collection containers. Additionally, our sensor technology measures the fill level of the recycling containers. Due to the wide range of sensor applications, Pepperl+Fuchs serves as the main supplier of inductive and photoelectric sensors, as well as ultrasonic sensors.” says Yngve Bekkevik, System and Solution Engineer at Pepperl+Fuchs. Long-term customer relationships like these contribute significantly to the success of the Mannheim-based family business. “Finding the right third-party supplier who offers the perfect production components is a challenging task in our expansive market. The close and positive cooperation between TOMRA and Pepperl+Fuchs has been an important contribution to our success.” says the Manager of Strategic Sourcing at TOMRA Systems, Liv Grønvd.

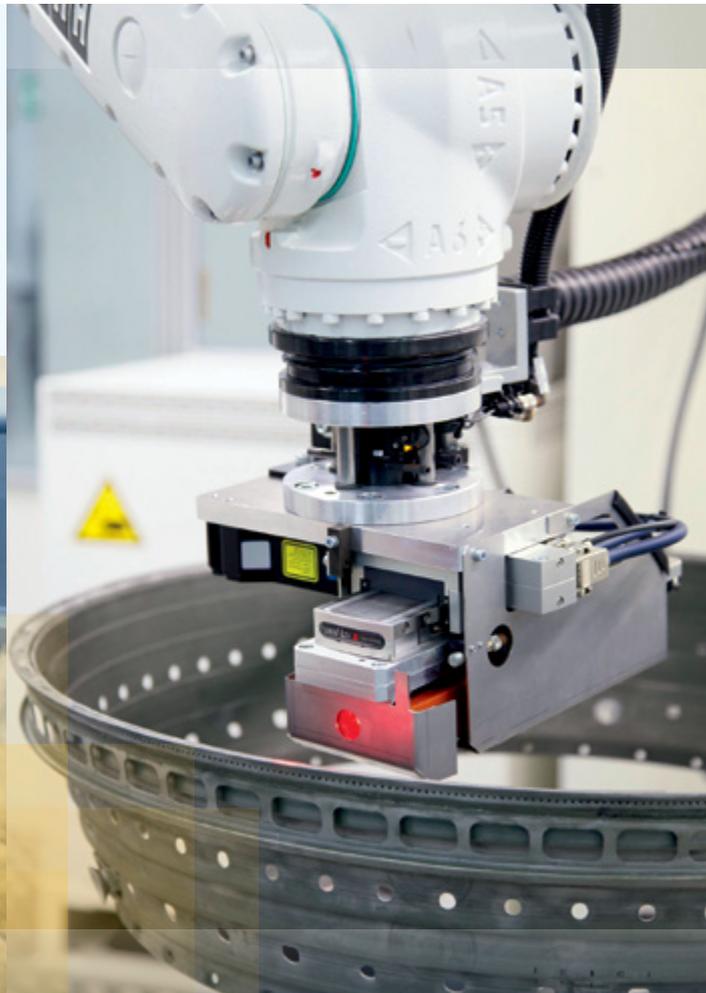
One Machine – Various Solutions

How these engineered solutions take shape is demonstrated by the sensor technology used in reverse vending machines. Most of the automation components by Pepperl+Fuchs are placed in the sorting part of the machine. The detection of cans and bottles can be a demanding measuring task. Today, many bottles are extremely

thin, thus their detection calls for special efforts. For this reason, the photoelectric ML7 retroreflective sensor is the right choice for clear glass. In other parts of the machine, you find ultrasonic sensors in the compact F77 housing. Along the sorting conveyor, inductive sensors are used to detect the proximity of metal parts and rotation speed. In the sorting bin, ultrasonic sensors have still another use: The F54 model detects both the presence and fill level of the collection container. “As the transmission and reception range of ultrasonic sensors is club-shaped, these sensors do not detect one single point, but rather a large, extensive measuring range of varying sizes. This gives an advantage for detecting irregular surfaces, such as compressed plastic bottles,” explains Carsten Heim, Ultrasonic Product Manager at Pepperl+Fuchs. If the collection containers are full, or if someone has forgotten to place a container back in the machine, the ultrasonic sensors emit a signal. “With this setup, a single sensor is used to measure the filling level and to position the container,” says Heim. Since the level of the collection containers is measured on an ongoing basis, store employees are alerted in a timely manner if the machine needs emptying. This prevents unnecessary downtime and makes shopping easier. ■

Reaching New Heights of Safety

Pepperl+Fuchs' subsidiary VMT (Vision Machine Technic Bildverarbeitungssysteme) is part of the challenging AutoInspect research project launched by Lufthansa Technik AG. The goal of the project is to develop a fully automated system for detecting and evaluating cracks in combustion chamber components.



The doors are closed. The wheels start rolling. The turbines are howling. At this moment, the powerful giant rises, floating in the air. Achieving a smooth, safe flight requires maintaining the airplane in top condition down to the millimeter. In aviation, one of the big challenges in engine maintenance and repairs is to be able to accurately detect tiny hairline cracks inside combustion chambers. A method known as dye penetrant inspection is used for this purpose. It is an established process that encompasses several steps. In simple terms, a penetrant – a fluid with low viscosity – that contains fluorescent dye is applied to the component. This fluid penetrates into even the tiniest cracks through capillary action. After a surface cleaning, drying, and then wetting with a substance called developer powder, ultraviolet light is used to reveal the cracks. This process makes it possible to detect even the tiniest

cracks. Dye penetrant inspection is a highly effective, but tedious and time-consuming method. It is also energy-intensive and can have an undesired environmental impact.

Fully Automated Crack Detection of Combustion Chamber Components

The Engine Services division at Lufthansa Technik has set itself the goal of continuously improving engine component maintenance processes for customers. Automation plays an ever-larger role in this, from inspection and parts measurement to repairs. To implement the first step in this future automated process chain, the AutoInspect research project was launched in April 2011. Its goal: fully automated detection and evaluation of cracks in combustion chamber components.



With support from the Hamburg Departmental Authority for Economic Affairs, Transport, and Innovation, Lufthansa Technik brought prominent partners on board: the Institute of Aircraft Production Technology at the Hamburg University of Technology (TUHH), which is responsible for handling – and VMT. Collaborating with partner company Espace, with Dr. Werner Neddermeyer as project manager, the Pepperl+Fuchs subsidiary is responsible for sensors and image processing within the project. Marc-André Otto, who works in R&D at VMT and is deeply involved in the project together with Sönke Bahr, explains: “At VMT, we have the good fortune to be involved in unusual projects fairly often. But this one is definitely very special.”

Tiny Cracks and an Immense Volume of Data

The team had major challenges to deal with. First, there was the component in question: the external flame tube of a CFM56 engine. It has a diameter of approximately 750 mm and a height of approximately 200 mm and, because of its complex shape, it is very difficult to scan in one piece. The only possible way to achieve the necessary high image resolution was a white light interferometer. Because white light contains a large number of different wavelengths, it is possible to take accurate measurements. But the term does not actually say anything about its color.

In the AutoInspect project, the interferometer uses red light. The interferometer is susceptible to vibration, an issue that was resolved through the measurement system design. An industrial robot with six-axis serial kinematics guides the sensor components, while an external rotation axis moves the flame tube. The whole system is placed on top of a thick steel plate that is isolated from its surroundings via air springs. There are over 100,000 measurement fields per tube, yielding well over 100 gigabytes of data that need to be processed. “Transmitting, analyzing, and representing such an incredible volume of data wasn’t easy, but we did it,” Otto says. In addition, a damaged component often has local and global repercussions. Scanning the component with the high-precision interferometer quickly becomes impossible, because the measurement range is not very deep. This problem was solved with the LR 300 laser triangulation sensor from Pepperl+Fuchs, which helps adjust measurement positions to the current circumstances. After four years of research and trial phases, Lufthansa Technik now plans to obtain approval for the new method from engine manufacturers. After that, the method will be industrialized. While the AutoInspect project is running, another project – AutoRep – has also been launched. After all, once automated crack detection is in place, automatic repairs should follow. “We’re on the right track, but there’s still plenty of excitement ahead,” says Otto. ■

Standardized and Borderless

A standardized protocol where all the elements of an automation solution agree – a key factor for the smart factory of Industry 4.0.

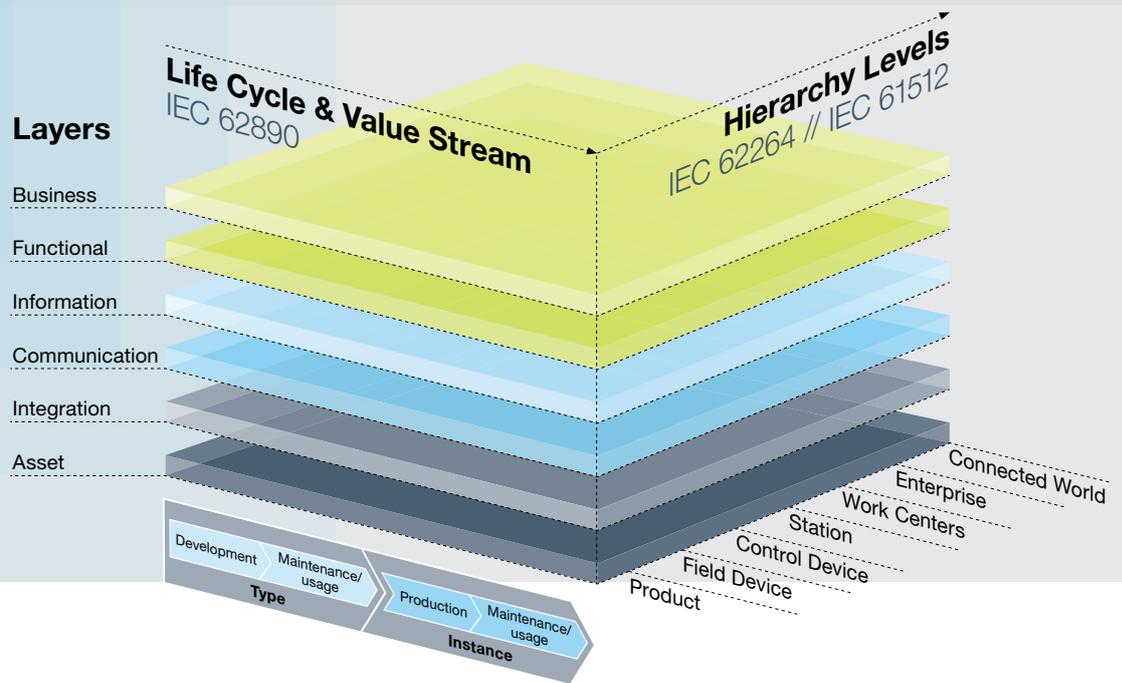


Around 7,000 different languages are spoken worldwide. That is why English is so often used as a bridge to help people of different nationalities understand each other. As production processes are more and more networked, a common basis for understanding is becoming important. This is particularly crucial in light of current developments in the industry: To ensure that all the elements involved in the production process of the smart factory of the future – from the plant to the product – can communicate with one another, a common, standardized protocol is essential.

Global Consensus on One Protocol

The concept of Industry 4.0 is breaking through borders that in many cases are still in place today. It is bringing systems that previously were separate much closer together: Going forward, it will not only be possible to exchange and process data across all levels of the automation pyramid within a company, but also globally between all industries. The new network structures that are emerging – without the vertical separation into layers within the company that is still common

today – are facilitating a truly flexible approach to production. These networked structures are making it possible for communication to be adapted, both vertically within a factory and horizontally along the value chain. In this respect, data security is just as important as finding a new, flexible approach to abstracting information sources and achieving a global consensus on a standardized protocol. In order to drive developments over the next industrial revolution, the German trade associations for information technology (BITKOM), the electronics industry (ZVEI), and mechanical engineering (VDMA) have launched “Plattform Industrie 4.0” (Platform Industry 4.0). Within the context of this initiative, representatives from the fields of politics, industry, and science, as well as trade unions, are working together to make recommendations to help achieve a networked Industry 4.0. This mix of backgrounds serves to highlight the fact that Industry 4.0 is an interdisciplinary concept. The challenges of the next industrial revolution can only be mastered by companies from the IT, mechanical engineering, and automation technology sectors working closely together.



RAMI 4.0

The first real result to come from the platform is the Reference Architecture Model for Industry 4.0 (RAMI 4.0), which was created as part of a working group for "Reference Architectures, Standards, and Standardization" under the leadership of Dr. Peter Adolphs, CTO at Pepperl+Fuchs. The three-dimensional model allows all the essential elements of the Industry 4.0 concept to be covered – from simple field devices, such as an intelligent sensor, to complex, globally networked production systems, taking into account the entire life cycle and all the organizational layers of the company.

The following section will take a brief glance at the horizontal and vertical axes of the model, to highlight the importance of having a standard communication system. The horizontal axis, "Hierarchy Levels", describes how an entity is classified into the former hierarchies within the organizational levels of a smart factory in Industry 4.0. In this regard, the RAMI model covers aspects ranging from the analysis of a product to be manufactured through the field device (e.g. an intelligent sensor), all the way to the "Connected World" outside of a production plant.

The vertical axis, "Layers", regulates the information technology aspects and provides digital maps of the assets of production plants. Taking the example of a sensor, the importance of the layers becomes obvious: The base is formed by the asset, in this case, the device, i.e. the sensor. The following integration layer covers everything that is necessary to make the sensor data available to the next layers. Above this is the communication layer, which creates a secure connection between the field device and the higher-level application software. The information layer encompasses the digital map of the assets, also known as the administration shell. In the functional layer, rules and decision-making logic are implemented. The top layer – the business layer – represents the business models and the business process as a whole. ❏



» OPC UA as Standard

Plattform Industrie 4.0 advocates OPC UA – UA stands for Unified Architecture (IEC 62541) – as a standard protocol. The communication standard enables data to be exchanged between all levels of a company and the connected world outside of the company. OPC UA includes various transport layers, as well as a semantic data model to ensure the meaningful display of information. In addition to the clearly specified semantic data models, OPC UA also features mechanisms for storing and providing historical data, for signaling events, and for executing functions on the server. OPC UA is an open standard, independent of any particular manufacturer. When using OPC UA in productive systems, one key factor is that each device that makes its functionality available via an integrated OPC UA server can provide a kind of self-assessment to other communication partners. This eliminates the need for the usual distribution of description files, such as IODD or GSD files, via a separate channel. Instead, when a client accesses the server, all properties are immediately available in a sorted, searchable tree.

By using discovery servers, the properties of registered devices can be searched before the connection is established. The discovery server also provides the requesting entity with information on how the relevant device, such as a sensor, can be reached via the network. An integrated security and authentication concept ensures the secure exchange of data between communication partners in OPC UA. If the corresponding access authorizations are available, OPC UA enables the seamless and universal exchange of information across all levels of an organization and its borders. Given the three-dimensional RAMI, this means that OPC UA can be unified with all layers and aspects of RAMI. ■

Three Questions to ...



Dr. Jörg Nagel, Senior Expert on Industry 4.0 – Industrial Internet Solutions at Pepperl+Fuchs

What Are the Advantages of OPC UA Compared to OPC Classic?

OPC UA is a successor protocol that delves much deeper and offers functionalities of which OPC Classic is not yet capable. For example, OPC UA is independent of any platform. However, the key advantage offered by OPC UA that makes it very interesting in terms of achieving a communication system within the scope of Industry 4.0 is the universal data model. What was previously determined by the application developer with OPC Classic is now standardized and independent of any particular manufacturer.

Thanks to the service-oriented architecture of OPC UA, any information technology system can access the data sources in the field. No special communication paths need to be maintained for the integration; simple network access is enough. As a result, a device with an OPC UA server can easily be integrated into existing systems.

Why Is OPC UA Particularly Suitable as a Standardized Protocol for Industry 4.0?

OPC UA can do more than just “transport” data from A to B. The actual transport layer is supplemented by a semantic data model, which enables semantic interoperability between all communication partners. From the field level and intelligent sensors, for example, it is not only the actual measured values (process data) that are forwarded, but information about the form, importance, context, and structure of the data as well. The sensors can be accessed directly via OPC UA from the IT level. The simple interpretation of the data is ensured by a kind of “self-assessment” of the sensor, which details its abilities.

How Do You View Future Developments Towards Achieving a Global Protocol?

I think it will take a while until all parties involved really agree on one protocol which can be used universally and also enables connection to cloud solutions, for example. A publish/subscribe mechanism, as is commonly found in message-based systems, is currently in development for OPC UA. In addition, OPC UA is not yet suitable for hard real-time applications, because no determinacy is given by the underlying TCP/IP. Concepts for the expansion of the transport layer accordingly, for example, through TSN (time-sensitive networking), already exist, so it can be expected that such expansions will find their way into the standardization of OPC UA in the near future. A universal protocol is essential, especially from a global networking perspective – otherwise production processes will only ever be able to communicate within companies and countries. With its standardized data model, OPC UA is very well-positioned in the race for first place. We should use the current lead to establish OPC UA as a protocol through which each element can communicate with all the others; after all, that is the core enabler of Industry 4.0. ■

Home

OF THE BRAVE + STATE OF

FRIENDS



The theme of the 2016 Hannover Trade Fair is “Integrated Industry – Discover Solutions.” This year, HANNOVER MESSE is partnering with the USA, the world’s largest economy, to showcase Industry 4.0 and the systems that bring intelligence, transparency, and increased productivity to the manufacturing floor.

The US is truly a land of superlatives. It’s home to some of the world’s most majestic mountain ranges, magnificent redwoods and sequoias, the Grand Canyon, and New York City, a global center of art, culture, fashion, and finance. It is a land of boundless promises, and it is where Pepperl+Fuchs, the Mannheim-based automation company, has had a base for over 30 years. Our cooperation is built on mutual exchange and fair strategies in all areas of our company – from innovative product development to intercultural marketing concepts.

US Continues to Expand

The United States is an interesting production location for German companies: Pepperl+Fuchs has been located in North America with a subsidiary in Twinsburg, Ohio for more than three decades. “The guiding principle for this location, which was opened in 1983, was to organize sales, development, transportation, and production with the customer requirements of the North American market in mind,” recalls Jim Bolin, Executive Vice President for North and South America at Pepperl+Fuchs. This principle was reinforced with the opening of two Solution Engineering Centers (SEC) in Houston, Texas. 



AMERICAN FLAG

The 50 stars of the American Flag represent the 50 states of the United States of America. Nowadays, the 13 stripes are symbols for the 13 colonies, which declared their independence from Great Britain in 1776.

WHY “STARS AND STRIPES”?

Stars are a symbol of the heavens and the divine goal to which human beings have been aspired from time immemorial. The stripes are symbolic of the rays of light emanating from the sun.



STATE OF OHIO

naturally

BEAUTIFUL

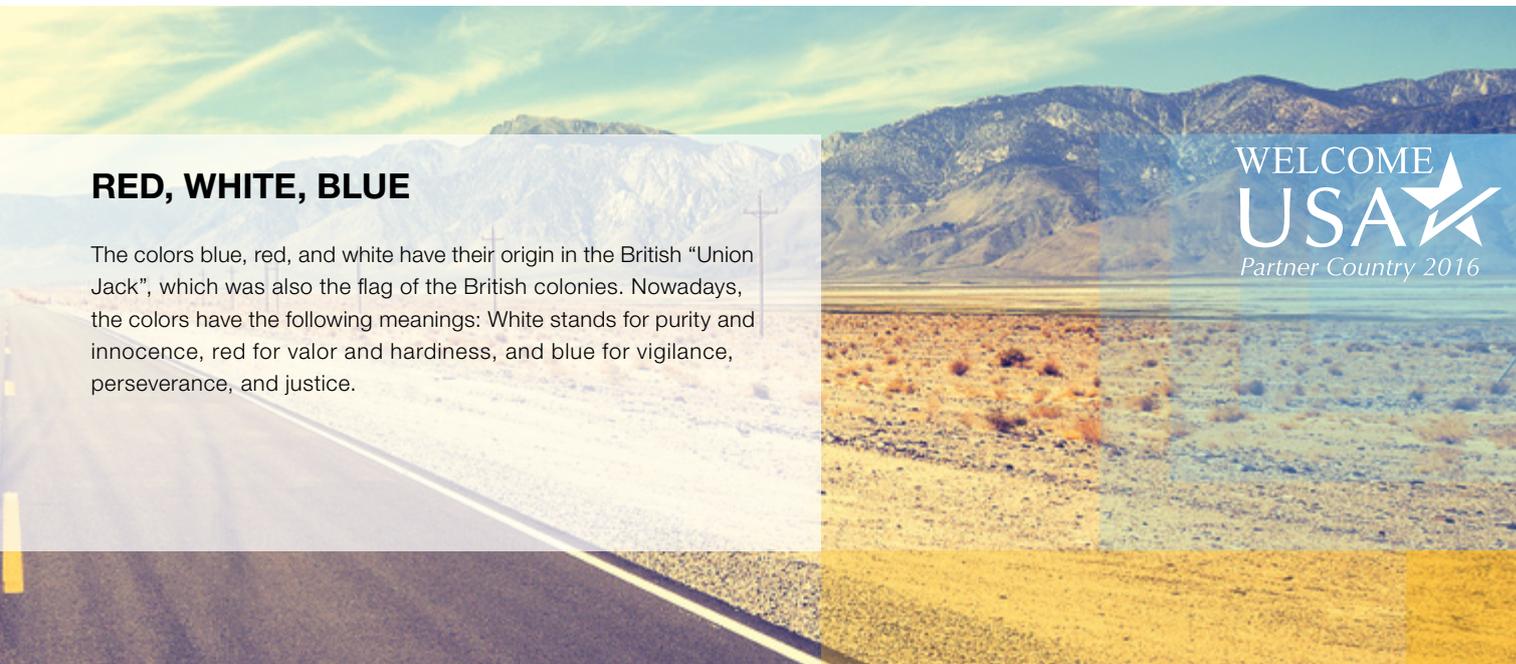


Did you know

A PAIR OF IDENTICAL TWINS RENAMED MILLSVILLE TO TWINSBURG AT THE BEGINNING OF THE 19TH CENTURY.



TWINSBURG HOLDS A YEARLY FESTIVAL JUST FOR PAIRS OF TWINS CALLED TWINS DAYS.



RED, WHITE, BLUE

The colors blue, red, and white have their origin in the British "Union Jack", which was also the flag of the British colonies. Nowadays, the colors have the following meanings: White stands for purity and innocence, red for valor and hardiness, and blue for vigilance, perseverance, and justice.

WELCOME
USA
Partner Country 2016

» Successful from the Start

Just 20 miles southeast of Cleveland, the Rock and Roll Capital of the World, you will find the North American headquarter of Pepperl+Fuchs in Twinsburg. More than a sales office, the site includes office space, R&D, manufacturing areas, a customer training facility, and distribution plants. The Twinsburg plant is the only global subsidiary to be responsible for a global business unit: The Global Center of Excellence and Innovation for Bebcos EPS and VisuNet HMI is based here. This year, Pepperl+Fuchs was voted best provider of industrial enclosure purge and pressurization systems by Control magazine in its 2016 Readers' Choice survey for the 13th consecutive year. In Twinsburg, the sensor modification group for factory automation works with customers one-on-one to modify and provide basic sensing products to solve unique application challenges. One of these unique solutions was the Pile Driver developed in 1997, a proximity switch designed for toughness and durability.

The Call of Black Gold

Texas is the second most populous and second largest state by area in the USA. An economic boom in Texas started when large oil reserves were discovered in 1901. The impact of this "black gold" changed the state's economy. Texas was transformed into a major petroleum producer and has become a key player in the US economy: from oil and gas production, to oil refining, to the petrochemical industry.

Texas Means "Friend"

The name Texas is derived from the Hasinai word Táysha' and means "friends" or "allies". "This association is a good reason for Pepperl+Fuchs to take up residence in this state and to strengthen collaborative relations with America with another subsidiary," explains Bolin. On May 1, 2013, the SEC opened its doors in Houston. This location mainly develops and produces control stations, switch cabinets, and purge and pressurization systems. It has over 1,100 m² of space available; more than 800 m² of this is dedicated to production. But Pepperl+Fuchs wants to take service to a new level.





Did you know



WHEN THE APOLLO

11

MOON LANDER TOUCHED DOWN, NEIL ARMSTRONG SAID, "HOUSTON, TRANQUILITY BASE HERE. THE

EAGLE HAS LANDED".



MORE THAN

90

LANGUAGES ARE SPOKEN THROUGHOUT THE HOUSTON AREA.



THE NICKNAME OF HOUSTON IS **SPACE CITY**



Close to the Industry, Close to the Customers

This spring, Pepperl+Fuchs plans to break ground on a 11,000 m² state-of-the-art warehouse and manufacturing plant near Houston that will house an expanded Solution Engineering Center, a customer training area, warehouse space, and distribution plants. "The warehouse will be a showcase for Pepperl+Fuchs products," says Bob Smith, Chief Operations Officer for Factory Automation in Twinsburg. "Customers will be welcome to visit and see how our technology is used in real-world applications." Rather than taking months to certify hazardous-location equipment, this new center will enable Pepperl+Fuchs to build and certify industry-leading products in a matter of days.

Houston, One of the Coolest Cities in America

In addition to Pepperl+Fuchs, thousands of corporations have relocated or expanded to Houston. In fact, Houston is home to more Fortune 500 company headquarters than anywhere in America except for New York. In 2012, Forbes magazine ranked Houston at the top of their annual list of America's coolest cities. Besides, Houston is home to the Lyndon B. Johnson Space Center. It is the home of America's astronaut corps, and the place where astronauts are trained to go to space. Even on the hottest days of the year, Houston is a pretty cool city.

Made in USA – the Benefits of Customer Proximity

Pepperl+Fuchs' growth has been tremendous, our continued commitment and investment in the Americas and Houston is significant. The "Made in USA" mark is important for the American market. Many Americans insist that products are manufactured in their home country. For years, the US sent more and more of its manufacturing to lower-cost corners of the global economy. However, it has now become profitable again to produce locally. Service is also a critical success factor in America: "Service quality is vitally important," says Bob Smith, Chief Operations Officer for Factory Automation in Twinsburg. He adds: "Today we are focusing more and more on increased customer service. This ensures greater customer proximity – as we have had for over 30 years." ■

Weighing Over 300 Kilos and Always Hungry



Every year, poachers in South Africa kill hundreds of rhinos to sell their horns for money. The young ones are often left helpless. Pepperl+Fuchs has now adopted an orphan baby and given “Oz” a new home.



They have inhabited the earth for almost 50 million years. Other animals rarely bother them – hardly surprising, considering they weigh up to 1.5 tons and measure up to four meters in length. We are talking about rhinos, which, despite their size, are threatened with extinction. This is because these enormous leaf and grass eaters have a ruthless enemy against which they are defenseless: Illegal hunters who have their sights on the horns.

In Asia, the rhino horn is seen as a means of salvation – reason enough for poachers to hunt the animals. They shoot the rhinos or tear their horns from their flesh while alive, leave the rhinos to bleed to death, and turn the horn into powder. This they then smuggle to China and Vietnam via an illegal network of traffickers. This is a major problem in South Africa, which is home to around three-quarters of the world’s rhinos. The young are often left alone, hungry, and disoriented.

An orphaned baby rhino from Kruger National Park has now found a new home thanks to Pepperl+Fuchs. The company adopted the young male rhino, gave their protégé the name of the magician Oz – Hebrew for force – and put him in the care of a wildlife reserve. His “adoption contract” has already been signed, and Oz has settled in well. The one year-old “baby” already weighs over 300 kilos, and guzzles up to 16 liters of milk a day – after the experience in the park, he needed additional nourishment. When Oz is an adult in two years and strong enough, he will be released back into the wild. ■

01

02

03

04

NIE – NORTHEAST CHINA INTERNATIONAL INDUSTRY EXHIBITION

April 24–26 // Booth D046, W2 // Shen Yang, China

HANNOVER MESSE

April 25–29 // Hall 9, Booth D76 // Hanover, Germany

17TH EXHIBITION OF LIJIA INTERNATIONAL MACHINERY 2016

May 11–14 // Booth B225, N2 // Chongqing, China

SPS IPC DRIVES ITALIA

May 24–26 // Hall 3, Booth A 042 // Parma, Italy

ELIADEN 2016

May 31–June 2 // Booth C02-12 // Lillestrøm, Norway

CEMAT

May 31–June 3 // Hall 27, Booth D43 // Hanover, Germany

05

07

06

MANUFACTURING EXPO 2016

June 22–25 // Hall 101, 1C09 // Bangkok, Thailand

08

ONS

August 29–September 1 // Booth 750 // Stavanger, Norway

TAIPEI INT'L INDUSTRIAL AUTOMATION 2016

August 31–September 3 // Taipei, Taiwan

09

SINDEX 2016

September 6–8 // Hall 2.2/A02 // Bern, Switzerland

SEPEM SUD-OUEST

September 27–29 // Toulouse, France

MEORGA MSR-SPEZIALMESSE SÜDWEST

September 28 // Ludwigshafen, Germany

10

SCANAUTOMATIC/PROCESSTEKNIK

October 4–6 // Gothenburg, Sweden

OTD

October 19–20 // Hall B-1090 // Bergen, Norway

11

MEORGA MSR-SPEZIALMESSE RHEIN-RUHR

November 9 // Bochum, Germany

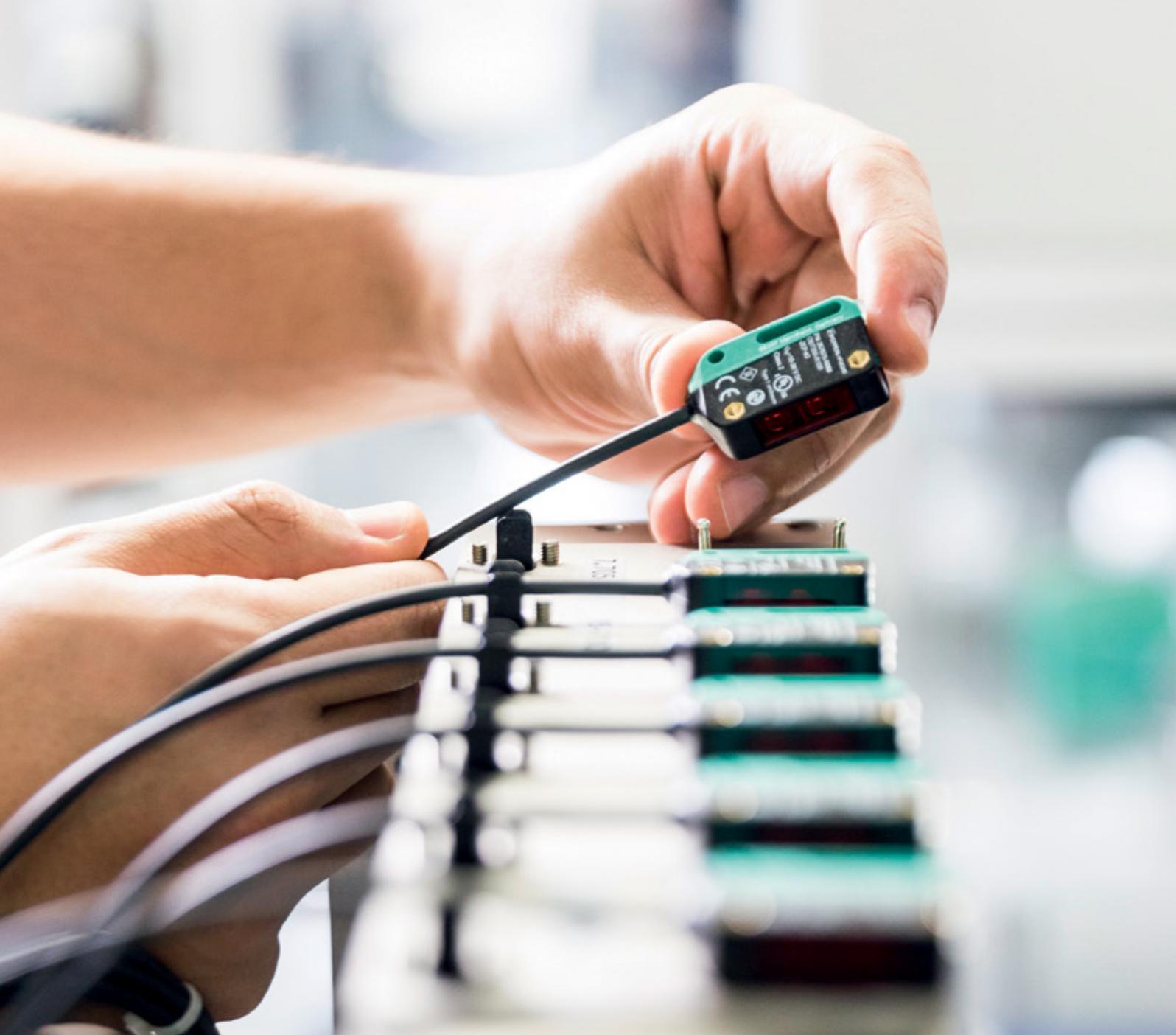
SPS IPC DRIVES

November 22–24 // Hall 7A, Booth 330 // Nuremberg, Germany

VALVE WORLD

November 29–December 1 // Hall 4, Booth 4A22 // Düsseldorf, Germany

12



Imprint

Publisher

Pepperl+Fuchs GmbH
Lilienthalstrasse 200
68307 Mannheim · Germany
Phone: +49-621-776-4411
E-mail: fa-info@pepperl-fuchs.com

Edition: 36,000

Year of publication: 2016

Part No.: EN 200237

© Pepperl+Fuchs GmbH

Editorship

Anne-Kathrin Lange, Bianca Willhauck
newsletter@pepperl-fuchs.com

Design: www.ultrabold.com

Pictures: shutterstock.com, Getty Images,
Liebherr Tower Cranes

Printed by: www.colordruck.com

News for Factory Automation is published twice a year. All rights are reserved. The reprinting or electronic distribution of articles or excerpts of articles is prohibited without the express permission of the publisher.

Links to third-party websites

If you choose to visit external websites via links printed in the newsletter to other non-Pepperl+Fuchs Group websites, the company is not responsible for the privacy policies and terms of use of those sites. The company has no control over such websites and resources; it does not endorse and is not responsible for the availability of external sites.

www.pepperl-fuchs.com

 **PEPPERL+FUCHS**