PEPPERL+FUCHS

News for Process Automation

2/2015

Free Flow of Data in Process Automation
A concept study and a demonstrator model by Pepperl+Fuchs show that continuous data flow down to the field level is possible via Ethernet.

VisuNet GXP for Zone 1/21
The highly functional thin client solution VisuNet GXP sets new standards in Zone 1 and 21 for the life sciences.

The Fourth Industrial Revolution Is Driving the World Forward
Industry of the future is not just an important topic for companies but also for entire nations – from Asia to Europe and America.

Dear Reader,

Developing different points of view and forging new paths to continuous communication – these are the challenges we face in the fourth industrial revolution. Taking full advantage of the wealth of information provided by the Internet of Things calls for a broader point of view. Imagine a camera or a mobile device helping you find the reason for an error in your processing plant – or if you could easily get additional computer-generated information about a complex topic.
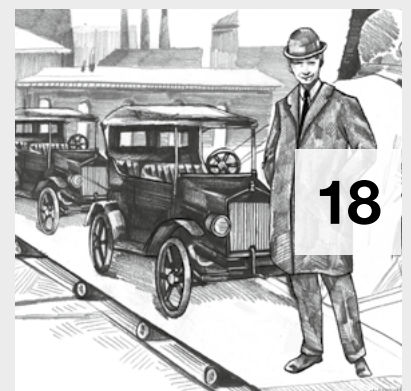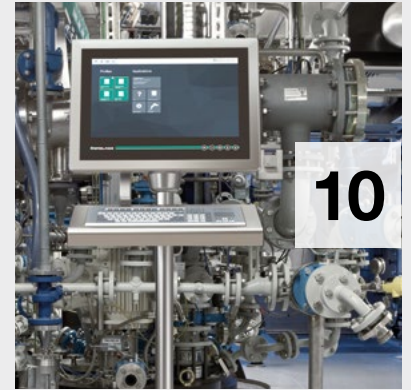
Augmented reality (AR) makes possible new forms of collaboration between human beings and machines. With AR, normally inaccessible areas within a machine, such as a robot cell, are being made accessible so that all of the information about a machine can be displayed. This virtual content is integrated into a real-world view, and as a new interface, it provides more efficient communication inside the smart factory. Augmented reality extends human and machine perception as the digital and the material world become one. New ways of interaction and communication emerge.

Our printed newsletter has also been upgraded to a new "reality," which can only be experienced via smartphone or tablet computer. For more information on "reality behind the scenes," please download our AR app. To view the AR information, hold your smartphone or tablet PC over the related AR markings.

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**

Contents

Technologies + Products

Applications + Knowledge

Markets + Trends

Augmented Reality

Would you like to see more? It is easy to download our augmented reality app. Hold your smartphone or tablet with the app above the AR markings inside this issue for more information!
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Free Flow of Data in Process Automation

In offices and factory automation, Ethernet is the basis of fast IP communication. However, the world of process automation still works with two-wire cables and 4 mA...20 mA. But a concept study by Pepperl+Fuchs demonstrates that continuous data flow via Ethernet is actually possible in process automation.

Ethernet, the standard form of communication technology for the constant flow of data, is nowadays almost as common as running water and power connections. Ethernet protocols are standardized worldwide and supported by virtually every automation system. Until now, due to a number of reasons, it has not been possible to use this widespread technology at the field level in process industries. Cable lengths that are too short, a lack of solutions for hazardous areas, too many wires in the cable, and the fact that connectors are unpopular in the process industry have proven to be the largest obstacles.

To extend continuous communication via Ethernet down to the field level, a group of well-known companies from all over the world has joined under the name "Advanced Physical Layer (APL)." Its goal is to develop common standards and basic concepts for Ethernet for applications in process automation.

As a member of this group, Pepperl+Fuchs has presented its own concept study, and developed a demonstrator based on this study. That it works in practice has already been demonstrated: Ethernet and process automation can be unified, and the technical requirements of the plant operators can be fulfilled. The demonstrator can achieve a transfer rate of up to 10 Mbit/s, and the standard fieldbus two-wire cable that is used can cover a distance of up to 1,200 meters. The Ethernet connection for the field devices is intrinsically safe, and is therefore suitable for use in Zone 0 or Class 1 Div 1. The data transfer supports all IP protocols, regardless of the fieldbus standard that is used, which fulfills an important prerequisite for continuous communication in the process industry.   》

Ethernet for Process Automation

An interview with Michael Kessler, Executive Vice President Components & Technology, and Lutz Liebers, Head of the Division Process Automation.

Why do we need Ethernet for the process industries?

Michael Kessler: For a number of reasons. Future system architectures, as they are being discussed in the context of the activities related to Industry 4.0, require seamless, direct communication through all levels of an automation system. Ethernet is perfect for this. At the moment, if this communication takes place at all, this is only via network transitions, which always create a bottleneck that requires laborious configuration. The requirements for the bandwidth for the data transfer are also increasing. Processes are becoming faster and the volumes of data transmitted during the configuration of the devices continue to increase.

Why has Ethernet not been expanded so far?

Lutz Liebers: The process industries have good reasons for working with two-wire cables. The power consumption of conventional Ethernet is far too high for the requirements in the field, and especially in hazardous areas. In addition, there are increased demands on the robustness of the connectors to ensure signal transfer over the entire lifecycle of a process plant – not to mention plants in the far North or on the Persian Gulf. And the maximum length of a standard Ethernet cable of 100 meters is much too short for a refinery or a large-scale chemical plant.

Can these physical barriers be overcome?

Lutz Liebers: Yes, that is perfectly possible if you work on the physics of the signal transfer. Using our demonstrator, we can show the potential practical implementation.

What are the special features of this demonstrator?

Michael Kessler: We have intensively studied different modulation methods and have chosen one that is ideally suited to use in process automation. It requires very low power, so it meets the requirements for a simple implementation that is intrinsically safe. The modulation method allows us to achieve a high data rate over a long cable length, without having to compromise on noise immunity. »

HAZARDOUS AREA
Zone 2/Class I, Div. 2

HAZARDOUS AREA
Zone 1/Class I, Div. 2

HAZARDOUS AREA
Zone 0/Class I, Div. 1
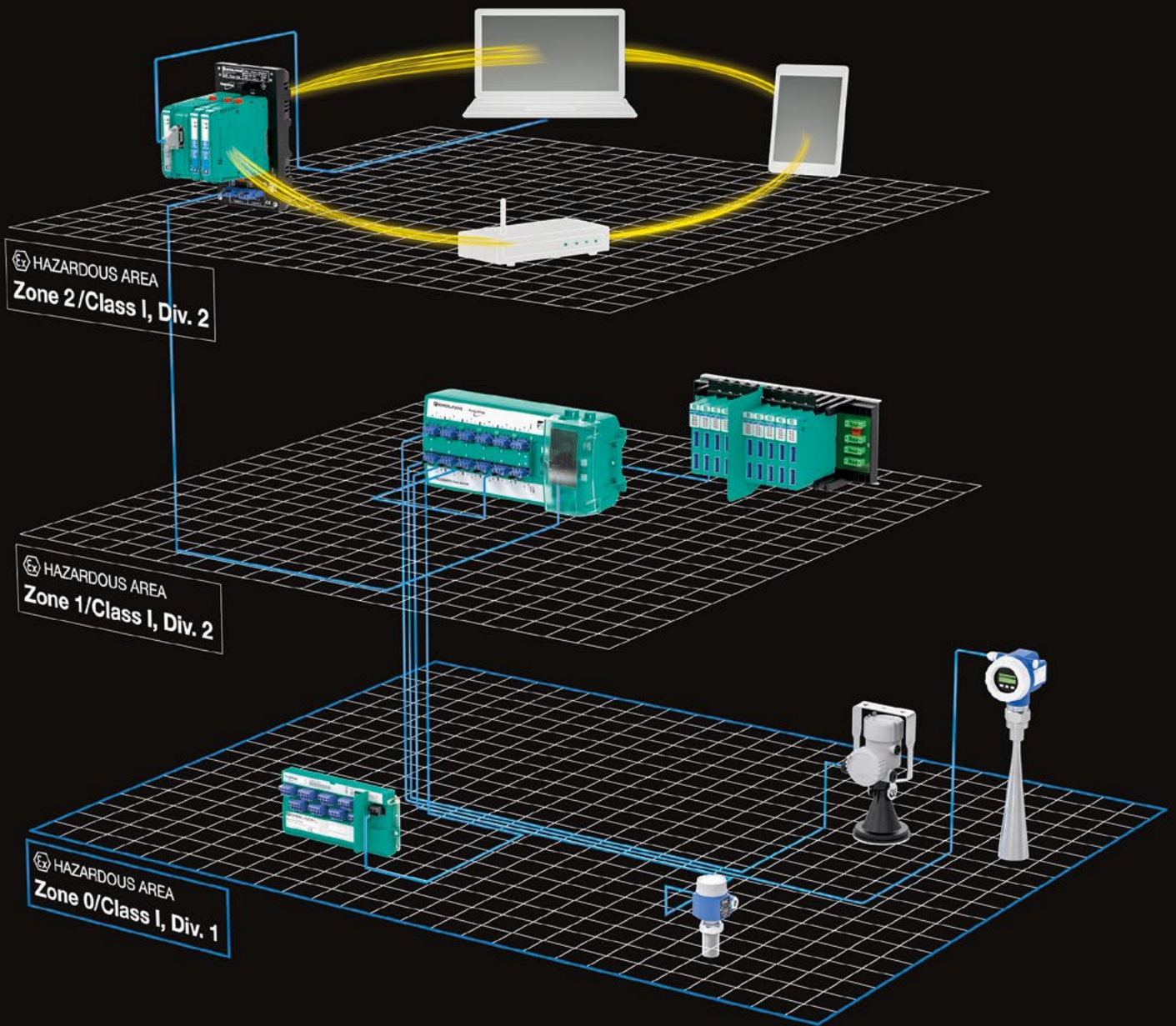
The PA Ethernet Demonstrator ...

... from Pepperl+Fuchs represents the typical communication architecture of a process plant. The devices have their own web servers, and the entire wiring takes the form of a two-wire fieldbus cable that transfers data and energy. Device descriptions, certificates, and manuals are stored there. PACTware can scan the network topology and automatically load the FDI device packages from the field devices. A field switch for hazardous areas provides intrinsically safe ports for connecting the Ethernet-enabled field devices.

The signal transfer is compatible with all Ethernet protocols. The cabling for PROFIBUS PA and FOUNDATION Fieldbus can be used, and conventional fieldbus devices can be connected to the field switch directly.

> "On a small scale, the demonstrator represents the typical communication architecture of a processing plant with Ethernet signal transfer, and shows that Ethernet can fulfill the requirements of the process industry for use in the field."

Michael Kessler,
Executive Vice President
Components & Technology

The implementation is so efficient and compact that it can be economically integrated into a simple head-mounted temperature transmitter. A two-wire cable can supply up to 60 field devices and the corresponding switches with power, and allow them to communicate. The entire architecture is based on switches, which ensures compatibility with all commonly used Ethernet protocols. One feature that stands out is the migration from today's digital fieldbus solutions.
The switch installed in the field automatically detects when a PROFIBUS PA or FF device is connected instead of an Ethernet field device. The switch then adapts the baud rate and protocol at the corresponding port, and converts the data to Ethernet.

How did you develop the study and the demonstrator?

Michael Kessler: From the very beginning, it was clear to us that the existing Ethernet technology is not suited to the special conditions in the process industry. That is why we carried out a detailed study on this topic a few years ago. As a member of the APL consortium, we then took the initiative and translated the results of this study into our demonstrator. On a small scale, it represents the typical communication architecture of a processing plant with Ethernet signal transfer, and shows that Ethernet can fulfill the requirements of the process industry

for use in the field. We have exhibited our demonstrator at the Hanover Fair and Achema. I have been to numerous trade fairs in the past 28 years, and I have never experienced a level of interest like this exhibit received. Many visitors came several times, with new questions each time, and they usually brought colleagues with them.

What was the main thrust of the conversations?

Lutz Liebers: This really depended on the individual user. The benefits and the new opportunities were always an important issue for users. The visitors were particularly impressed that an Ethernet field device can deliver everything that is needed for commissioning, and for operation. Configuration takes place via a web browser, and manuals and certificates are stored in the device, and directly available via download. An asset management system (which we showed with PACTware) can identify all the connected devices in one scan, and load the FDI Device Package directly from the device. The benefit is obvious: an enormous simplification of the engineering, of the installation, and of the operation of the devices, as well as the seamless flow of data. Another highlight was the possibility to connect "normal" fieldbus devices. In particular, the process industry with its very long plant lifecycles is dependent on today's technology still being supported in the long term.

"Ethernet bridges the gap for process automation to Sensorik 4.0, which we see as an essential foundation for Industry 4.0."

Lutz Liebers,
President
Division Process Automation

By contrast, the device manufacturers were more interested in how you can bring Ethernet into a field device. Here, we kept unscrewing the cover of the transmitter on our exhibit showing the small PCB that establishes the coupling between a standard HART device and Ethernet for process automation.

What kind of bandwidth can be achieved?
Michael Kessler: We can reach up to 10 Mbit/s. This is more than 8,000 times greater than HART, and still more than 300 times the transfer rate of PROFIBUS PA or FOUNDATION Fieldbus. It also means that we can manage the volumes of data that would be generated in an Industry 4.0 environment.

And since we're talking about Industry 4.0, how important is the APL for this?
Lutz Liebers: We believe it is a crucial prerequisite. In process automation, Industry 4.0 works only if it can successfully transmit large volumes of data from the field level of the process plants into the Industry 4.0 architecture information level. The prerequisite for this is a uniform communications architecture across the plant that does not require network transitions.

Are we therefore about to see a significant shift in process automation?
Lutz Liebers: Plants in process industries are designed for decades of operation. For this reason alone, there will be no rapid conversion on a large scale. However, a gradual migration is part of the concept; the cabling remains unchanged and combining Ethernet with conventional fieldbus devices is possible. I am sure that traditional and IP-based technologies will exist alongside each other for a long time.

Is there a danger of a new fieldbus war?
Michael Kessler: No, that is out of the question. The APL is a common standard for continuous signal transfer not a new fieldbus. It remains open for all fieldbuses and protocols.

What would functioning PA Ethernet mean to the users of field devices and sensors?
Lutz Liebers: Users will be able to take full advantage of the wealth of information provided by modern field devices and sensors. Ethernet bridges the gap for process automation to Sensorik 4.0, which we see as an essential foundation for Industry 4.0. ∎

VisuNet GXP for Zone 1/21

New Full HD Multi-touch Monitor

Operating and Monitoring Systems   Compact, lightweight, modular, and with a 21.5-inch Full HD multitouch display: the combination of these features makes the VisuNet GXP Remote Monitor industry transforming. The highly functional, cost-effective thin-client solution sets new standards in Zone 1/21 within the life sciences.

Upon installing the new VisuNet GXP, it will not take long to realize its decisive advantages. It is obvious at first touch – this thin-client-based monitor solution for Zone 1/21 will be easy to install. Traditionally, Zone 1/21 solutions are bulky and heavy: with the GXP, it is quite the opposite. At just less than 30 kilograms, this new development from Pepperl+Fuchs is a true lightweight – unlike any other Zone 1/21 system. This means that it is possible for just one person to easily install the compact device. The modularity is a big plus: the display, computer, and power supply are all easy to disassemble on-site, making field maintenance easy and reducing the costs associated with downtime significantly.

The thin-client unit, developed by Pepperl+Fuchs, is the core of the VisuNet GXP Remote Monitor. In 2007, Pepperl+Fuchs introduced the first thin-client solution for hazardous areas: the VisuNet Remote Monitors. Since then, the company has been constantly developing the technology further, and is now setting new standards for life-sciences applications with the VisuNet GXP.

Large Capacitive Multi-Touch Display

Despite its lightweight design, the developers have not sacrificed on the display size of the VisuNet GXP. With a 21.5-inch screen and Full HD resolution (1920 x 1080 pixels), the display is equivalent to the common widescreen format and guarantees optimal display of the process images. The capacitive multi-touch sensor is located behind the hardened protection glass and is therefore not only extremely durable and scratch-resistant, but also optimized for use while wearing gloves. The sensor allows the design of modern, touch-optimized user interfaces similar to smartphones and tablets. The multi-touch capability makes it possible to introduce safety aspects to critical processes. For instance, it is possible to specify that an application can be started only by touching two contact points simultaneously, making inadvertent activation almost impossible.

The stainless steel design, in conjunction with the smooth surface of the monitor and surface components such as the surrounding enclosure and the keyboard, prevents the accumulation of liquids, dirt, or bacteria. The continuous glass front display supports optimal cleaning – this is why the VisuNet GXP meets the high demands of the life-sciences industry and meeting GMP guidelines. Such a highly functional and cost-efficient thin client solution for hazardous areas is particularly beneficial for pharmaceutical and fine chemical applications.

Easy Integration with Latest Firmware

The devices are equipped with the latest generation of firmware: RM Shell 4.0. The user interface enables easy integration of the VisuNet GXP Remote Monitor into a process control system. It takes just a few minutes to establish the connection via Ethernet. The user can easily access a variety of different process control computers from a single Remote Monitor. The monitor can be set up for automatic connection to the process control system after system startup. In the event of a host failure, the VisuNet GXP with RM Shell 4.0 firmware is even able to establish a predefined backup connection independently. This ensures the display of process images without errors at all times. ■

➡   **www.pepperl-fuchs.com/news-rm-shell**

New Ideas for Practice-Oriented Systems

Interface Technology   The SC-System signal conditioners have been on the market for approximately 18 months. Even after the successful launch, Pepperl+Fuchs has been engaging in intensive dialogues with users. Andreas Grimsehl, Product Marketing Manager for Interface Technology, gives an overview of the results and subsequent developments.

The launch of the SC-System was preceded by thorough market research. The new product family has now been successfully positioned on the market. Why are discussions with users still useful at this stage?

Requirements change continuously, from both a technical and economic perspective. For this reason, we use a two-stage procedure to regularly collect feedback from users after a launch. Our interface specialists, who are worldwide on-site with their sales organizations, gather and evaluate this information. These ideas are directly incorporated into the product management workflows.

To obtain this feedback, we carry out detailed interviews with selected customers and dealers in Germany and other international markets, such as Europe, China, India, or the United States. Furthermore, we are taking into account different industries, such as power plants, sewage treatment plants, cement works, or drinking water production.

What concrete insights do you take from these discussions?

Manufacturers often focus on the technical features of a product. However, the discussions have shown that it is not only the number and complexity of the features that make a product attractive. That is why we are also interested in its suitability for practical use – the mechanical properties, for example. Furthermore, we continuously optimize the "soft skills" of a product, i.e., service, support, or delivery times.

Moreover, new applications are always being added and these must be aligned with the features in our portfolio. For example, the use of small PLCs is increasing; these often have only passive voltage inputs and are suitable for only a few sensor types. These small PLCs cannot be used without the conversion function of the signal conditioners.

Our SC-System offers another major advantage: it is open. The signal conditioner market is characterized by a wide variety of suppliers. Our system is compatible with many other systems and is ideal for retrofitting or upgrading equipment. This is seen as a particularly positive characteristic. For example, a commercially available standard DIN mounting rail can be used for the Power Bus, and the terminal arrangement is based on the existing standards.

Have the conversations already led to tangible developments?

As a result of the customer feedback, the SC-System is now available with the Power Bus I mentioned. Whereas the modules could be wired only via the terminals initially, the Power Bus now offers an alternative for larger systems in the form of a central energy supply through an insert part for standard DIN mounting rails. This allows the modules to be supplied via power feed modules and also enables the use of a collective error message. ∎

What feedback have you received on the SC-System?

The discussions have confirmed that our portfolio features cover the essential applications. Compared to other signal conditioners, the key characteristics are very good – for example, the isolation with 3 kV test voltage and 300 V working voltage, as well as 70 °C maximum ambient temperature. With a height of 97 mm and a width of 6 mm, the SC-System is one of the most compact modules on the market.

➡ **www.pepperl-fuchs.com/news-sc-system**

Ex d Loop-Powered *Wireless*HART Adapter

WirelessHART   The BULLET is the first *Wireless*HART adapter with Ex d housing, which consists of an extremely rugged aluminum. This allows the unit to withstand harsh environmental conditions in process plants.

The loop-powered adapter enables new and existing wired 4 mA … 20 mA and HART field devices to communicate measurement, diagnostic, and parameterization data wirelessly. The BULLET is suitable for use in explosion hazardous areas up to Zone 1. There is an intrinsically safe version for use in Zone 0. Additionally, the adapter is available as a general-purpose version.

When using the BULLET, no additional battery is needed. The adapter supplies itself with energy from the 4 mA … 20 mA current loop, using a special technology called "StepVolt." This technology allows users to set insertion voltage from 1 V to 2.5 V in order to optimize the usage of available loop power and wireless communication bandwidth. The BULLET is equipped with a powerful multidrop feature, which makes it possible to multidrop up to eight field devices with one single BULLET. This is especially useful and cost saving for monitoring tank farms and pipelines. ∎

➡ **www.pepperl-fuchs.com/news-bullet**

Compact, Flexible and Reliable – the New 6500 Series

Purge and pressurization systems   **Purge and pressurization is one of the most flexible and most reliable methods of explosion protection. There is now scope for growth within this type of protection for the proven Bebco EPS® product family. The compact 6500 Series has been specially developed for the Zone 1/21 ATEX and IECEx markets.**

The measurement and monitoring of trace gases is essential for many processes in the petrochemical industry. The electronic gas analyzers used for these applications are permanently exposed to dangerous gases. Utilizing the flexibility and reliability of the purge and pressurization protection method, the 6500 Series of the Bebco EPS® product family is able to provide an effective and compact solution for these applications for the Zone 1/21 ATEX and IECEx markets.

Fully automatic monitoring and control

The state-of-the-art 6500 Series consists of a 316L stainless steel control unit and a flexible vent that permits low, high, or constant flow rates of inert gas or industrial grade air, depending on the application. The 6500 Series is a fully automatic solution for continuous monitoring and control of the purging action, power, temperature, and pressure in an enclosure. This ensures reliable protection of electrical equipment in potentially explosive areas. Both the control unit and the vent are suitable for internal or external mounting, allowing the system to be easily integrated into a variety of applications. To improve the level of user-friendliness further, the control panel with backlit display and touchpad allows easy configuration and convenient handling of the system.

Flexible connection with HART and Bluetooth

An exclusive feature of the 6500 Series is the ability to have continuous connection to the control unit with HART interface and Bluetooth compatibility. With its HART connection, the 6500 Series can provide various control and diagnostic features directly to an AMS or PLC system. With its Bluetooth compatibility, the user can connect and monitor multiple units wirelessly for seamless connectivity. This makes the new series a reliable state-of-the art protection method also for applications in the petrochemical industry. ■

AT HOME IN EVERY *OCEAN*

Marine-certified solutions from Pepperl+Fuchs are in place on tankers, oil rigs,
and floating liquefied natural gas facilities (FLNGs) all over the world. With their robust and
compact design, the sensors are ideal for withstanding the harsh conditions at sea. »

MARINE-CERTIFIED FIELDCONNEX®

The existing components of the FieldConnex® fieldbus portfolio were certified for marine use in 2015. The fieldbus diagnostic handheld (FDH-1) is ideal for work on the high seas. The mobile tool for fast and convenient fieldbus diagnostics analyzes the installation at the touch of a button and detects any deviations from the optimal value. For example, as a result of intelligent self-diagnostics, the lightning protection system sends a message to the diagnostics station or the FDH-1 in the event of wear and tear. The operator can then respond quickly when necessary. These diagnostic functions and proactive fault detection ensure continuous availability.
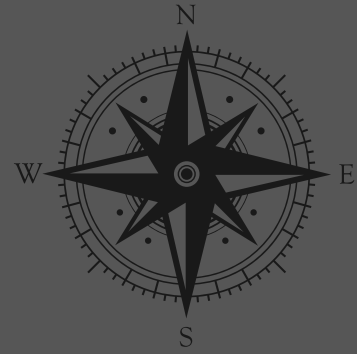
➡ www.pepperl-fuchs.com/news-fieldconnex

⏩ When we think of the sea, most of us imagine a picture perfect scene – dazzling sunshine and the deep blue water shimmering like glass as far as the eye can see. But day-to-day life on tankers or oil rigs is very different. Often, the sea displays its rough temperament. Storms, extreme temperatures, seawater, oil, and dirt are just some of the challenges that take their toll on the devices. Equipment must be robust enough to operate continuously despite the harsh environment, shocks, and vibrations. However, increased stability must not result in increased weight. And the lack of space on board requires a compact design – particularly on oil rigs and tankers for crude oil and natural gas extraction.

Given the growing demand for energy, the development of remote reservoirs at sea is becoming more important. Along with the challenge presented by the ocean's harsh environmental conditions, oil and gas extraction carry a risk of explosion. For monitoring equipment and signal transmitters, adequate protection is essential. Pepperl+Fuchs offers reliable and efficient solutions, which are certified by the world's largest maritime certification institute, Det Norske Veritas, for example.

Reliable Signal Transmission on Board

Floating liquefied natural gas facilities (FLNGs) clearly demonstrate just how important it is to have secure signal transmission on board. The natural gas is transported through pipelines from the ocean bed to the floating plant, where it undergoes additional processing steps on board, including cleaning and liquefaction of the gas. It is crucial that the pressure, temperature, and flow rate are monitored throughout all of these process steps. Pepperl+Fuchs offers solutions that are marine certified and specially designed for demanding process environments across all product groups.

Especially for big valve manufacturers, the company creates intrinsically safe NAMUR sensors and sensors for hazardous areas, which are suitable for offshore applications related to valve positioning. Where rotary motion must be accurately recorded and precisely controlled, rotary encoders for the offshore sector have

been developed. Remote I/O technology flawlessly transmits signals from analog field devices to the control system via PROFIBUS DP. With the most compact modular systems on the market, Pepperl+Fuchs offers a solution that can fit in the tightest of spaces.

The tried-and-tested, robust 4 mA … 20 mA interface technology is installed in fire and gas systems. Signal conditioners, Zener barriers, and isolated barriers from Pepperl+Fuchs guarantee reliable signal transmission between the position detectors and the control unit via point-to-point connections. Ex d enclosures are tailor-made with the required IP protection, and control cabinets are available pre-wired for all types of protection. The made-to-measure solution allows quick and error-free installation, thereby reducing downtime.

Highly Compact and Certified to the Latest Standards

The FieldConnex® product family from Pepperl+Fuchs is ideal for use at sea. The current portfolio was certified for marine use this year and was subjected to extensive testing, ranging from electromechanical tests to vibration resistance tests, and tests on behavior at extremely high humidity. "Reducing the amount of cabling by using two-wire cable instead of multicore cable means the fieldbus installation is lighter and takes up less space," explains Andreas Hennecke, Product Marketing Manager for fieldbus technology. "Because these solutions offer increased safety and intrinsic safety protection, lighter housing can be used. This was particularly true of the FieldConnex® power supplies, Segment Protectors, and FieldBarriers – currently the most compact and lightweight solutions of their kind."

The FieldConnex® temperature multi-inputs (TM-I) – which are certified for all hazardous areas – can bundle together up to eight thermocouples or resistance temperature sensors and bring these devices via just a single fieldbus address into the DCS. Network protocols such as FOUNDATION Fieldbus H1 or PROFIBUS PA are used. As a result, it is possible to operate up to 16 or more TM-I devices on one fieldbus segment. A total of 128 or more sensors for measuring temperature can be incorporated in a space-saving design using a small number of short cable connections and a two-wire main cable. Given that a high level of maintenance cannot always be provided on the high seas, the comprehensive diagnostic options and early stage failure detection of intelligent fieldbus infrastructure components are particularly impressive. For example, contact bounce protection, wire breakages, and short circuits are logged automatically to keep the installation running smoothly. The user can intervene at an early stage if necessary and find a solution. Downtime and costs can be kept to a minimum and runtimes at sea are significantly increased.

On-Site Maintenance Worldwide

Nowadays, more and more users are looking for complete system solutions from a single source. Experienced employees from Pepperl+Fuchs are being deployed all over the world to support companies in their journey from the initial planning stages to commissioning new systems. Solution Engineering Centers (SECs) are providing customers around the globe with tailor-made system solutions, including explosion certification and documentation. The offering includes individual solutions with purge and pressurization systems like those used in the ballast water treatment process (as reported in issue 1/2015).

Skilled employees also provide mobile service when assistance is required. Is the schedule for a sea trial getting off track due to a fault on board? On entering the next port, an expert is already waiting on the dock to make sure the boat can continue its journey without delay. ∎

The Fourth Industrial Revolution Is Driving the World Forward
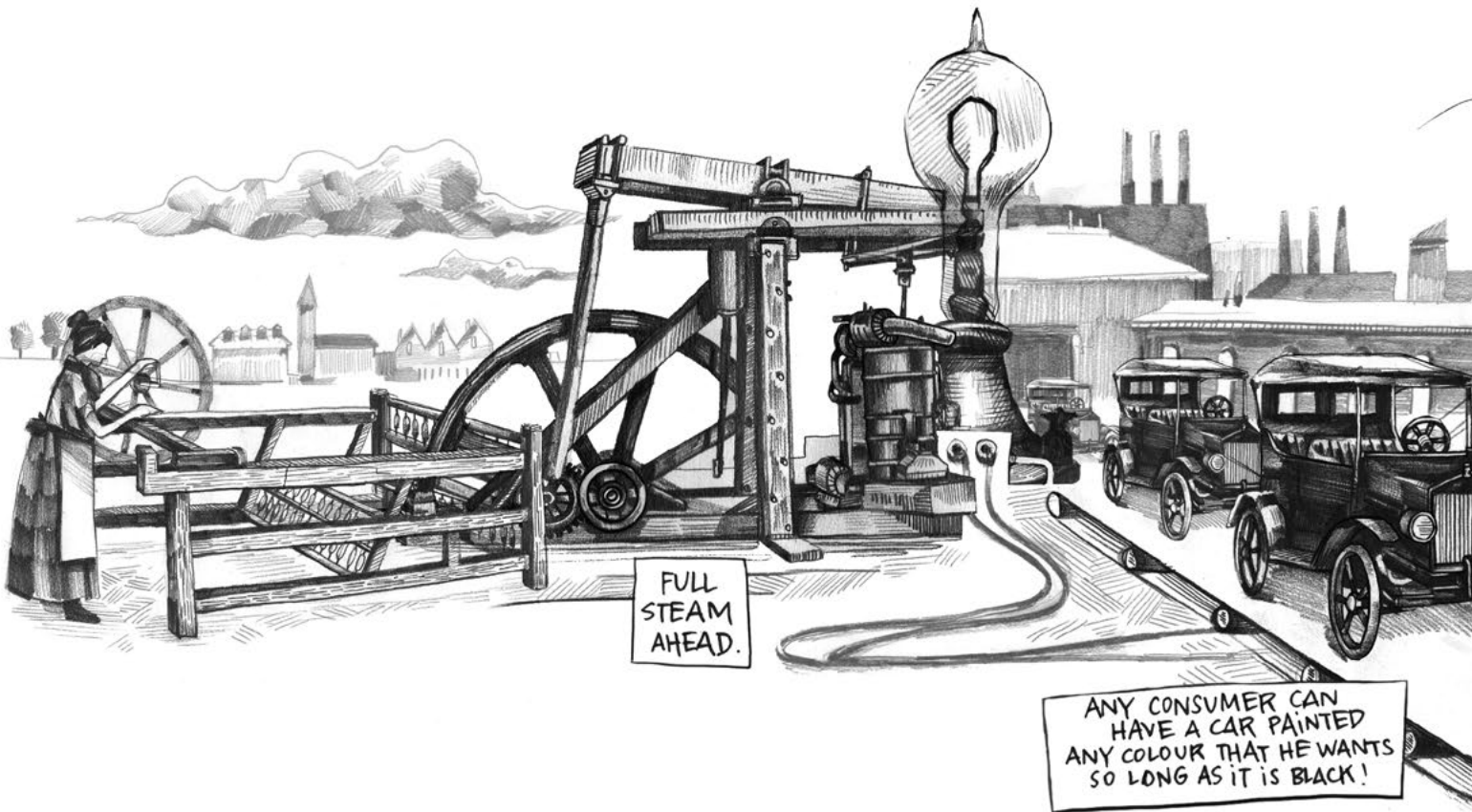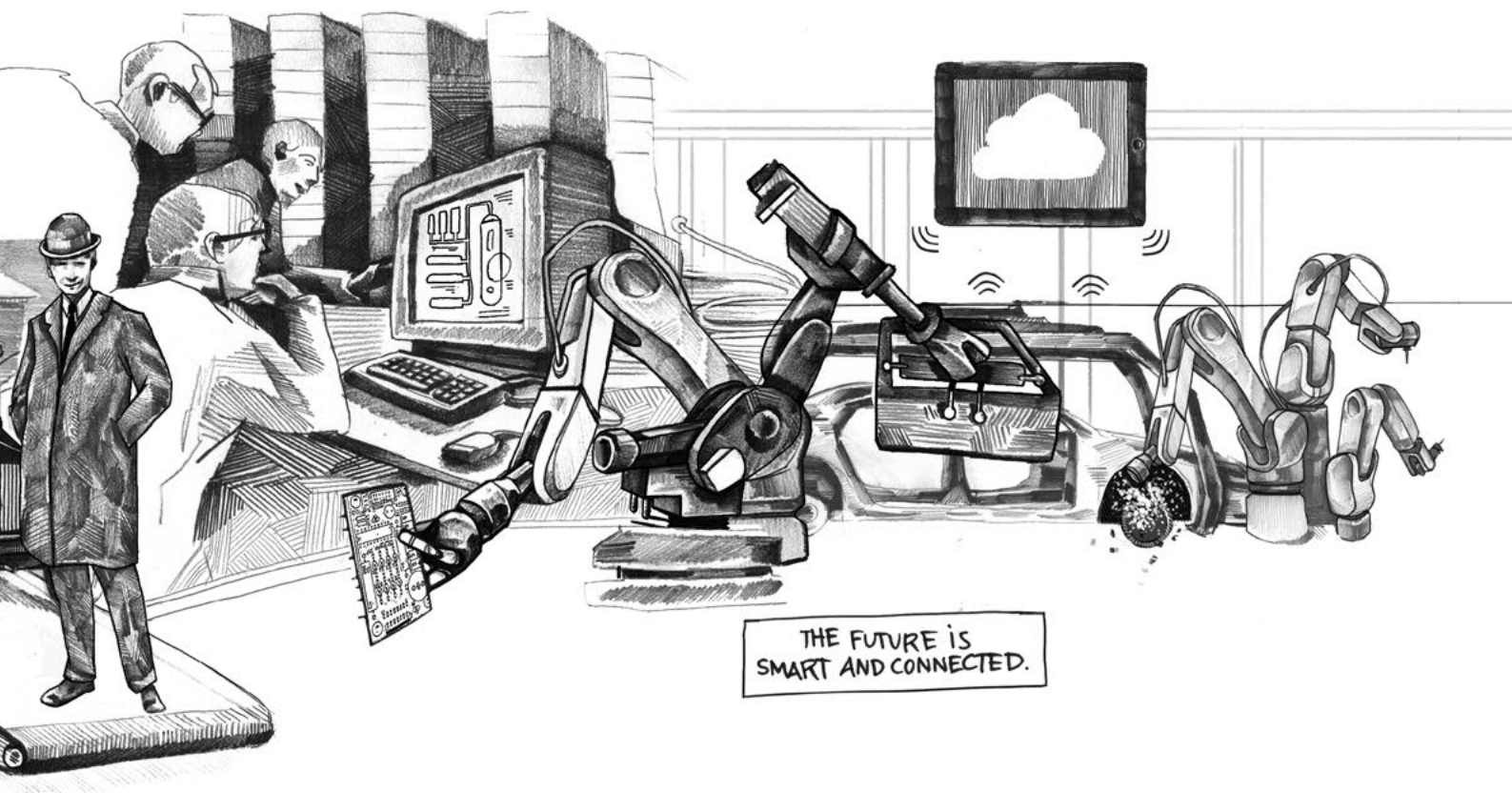

First Industrial Revolution

End of the 18th century

Many technical innovations such as the steam engine and the mechanical weaving loom were invented at the end of the 18th century. These inventions led to fundamental changes in civilization. Society went from being agricultural to industrialized.

Second Industrial Revolution

End of the 19th century

The effective use of electricity, the increased significance of chemical industries, and the invention of the assembly line were important for the second industrial revolution. Large-scale industrial mass production was the outcome of assembly line work. This led to another change in society: more and more people were now working in big companies, not in small firms as before.

THE FUTURE IS SMART AND CONNECTED.

Third Industrial Revolution

End of the 20th century

Digitalization, the use of computers, and automation of production processes at the end of the 20th century led to a transformation of industry that affected people's daily lives. Artificial intelligence was no longer fiction. In 1997, a computer beat the reigning human world chess champion in a game of chess.

Fourth Industrial Revolution

Today

The existing trend towards more individualized products will be even stronger in the future. To save money and time, a more flexible production process is crucial. This development is based on the availability of all relevant information in real time by networking all the variables that add value. It is not clear if this development can be named a revolution or if it is more a "natural" evolution.   »

Industry 4.0, Internet of Things, or Industrial Internet – these terms should be on the agenda of companies looking to position themselves for the future. This topic is not just important to firms, but also to entire countries. Experts predict that anyone who misses the boat now will feel the global economic effects in the future.

A note flashes up on the tablet. The truck driver takes a short look at it and sees a warning for a traffic jam. The new route is displayed immediately. As such, he will reach his destination on time. He is headed for the Port of Hamburg, where his cargo will be loaded and shipped from there to its international destination.

Europe's second largest container port has embraced the idea of Industry 4.0. By 2025, the total turnover in the port is expected to double to 296 million tons – an impressive figure when you consider that the port has a limited area of 72 square kilometers. An extension of the area is not possible, as the port is directly adjacent to the Hanseatic city. Sophisticated logistics are crucial for handling the increased traffic volumes in a stable manner. The intelligent, cloud-based logistics solution handles these requirements perfectly.

A comprehensive IT platform is used to collect information about the traffic, parking space, and the closed periods of moving bridges. This information is available in real time via tablets or smartphones. This reduces waiting times, avoids traffic jams, and allows faster handling. The aim is to network all those involved in the port logistics chain – from logistics companies, to port workers, and carriers.

From the World's Workshop to an Innovative Economy

Projects such as that being undertaken in the Port of Hamburg showcase the potential of Industry 4.0 applications. And it is not only the European economy that has long since caught on. "The subject of Industry 4.0 is also being promoted in Asia, in particular by the Chinese government," says Silke Besser, Managing Director of the German-Chinese Business Association. "As such, the 'Made in China 2025' growth plan has recently been unveiled with a clear goal in mind: by the middle of this century, China will be developed into one of the leading industrial nations."

The Chinese Ten-Year Plan: "Made in China 2025"

The Chinese "Made in China 2025" growth plan was presented in May 2015. The objective of the plan is to strengthen the manufacturing sector in China. The Chinese government has identified nine key areas: driving forward innovations in production, integrating industry and technology, strengthening the industrial base, supporting Chinese brands, implementing environmentally sound manufacturing processes, promoting breakthroughs in ten key sectors, advancing the restructuring of the manufacturing sector, promoting service-oriented manufacturing, and driving forward internationalization.

The country no longer wants to be thought of only as the "production site" for industrialized countries. "China wants to transform itself from the world's workshop into an innovative economy. Industry 4.0 is seen as a great opportunity to achieve this goal," says Silke Besser. "Although some of China's larger, internationally operating Chinese companies already have – regarding digitalization and intelligent networking – very advanced factories, the majority have still not progressed that far." Nevertheless, the Chinese government has declared its intention of catching up to the world's larger industrial economies over the next few decades.

Although other countries in Asia, such as Singapore, Japan, or Korea, do not have the same economic power as China in terms of volume and size, the concept of Industry 4.0 still plays an important role in these countries. Unlike in China, the issue is not being driven by the government in Singapore, Korea or Japan, but rather by the businesses themselves. This is not surprising when you consider the strong economic position and pioneering role that some Asian companies have assumed in developing important technologies for the future, such as robotics, batteries, or electric vehicles.

Defining Common Standards

In the United States, there is a growing trend toward digitization of the consumer market and IT companies. The Industrial Internet and the Internet of Things are key terms that are receiving a lot of attention in this respect. In 2014, five leading IT and telecommunications companies joined forces to form the Industrial Internet Consortium (IIC) to promote the Industrial Internet. The consortium now has more than 170 members from industry and research. Their goal is to exchange examples of best practice, define common standards, develop applications, and thereby create innovations for Industry 4.0 scenarios. One of the first results to emerge from this collaboration is the Industrial Internet Reference Architecture (IIRA), an architecture model closely related to software development. The aim is to develop standards that enable the exchange information between cyber-physical systems and their superordinate levels. »

industrial internet

USA

The Industrial Internet Consortium

The Industrial Internet Consortium is an open nonprofit organization. Companies, research institutes, and public institutions work together to continue to drive forward the Industrial Internet. The founding members were AT&T, Cisco, GE, IBM, and Intel. The organization now numbers more than 170 companies and associations that collaborate to promote the Industrial Internet, establish overarching standards, and address issues such as new security technologies.

➡ **www.industrialinternetconsortium.org**

Industrie 4.0
GERMANY

Platform Industry 4.0

Platform Industry 4.0 was originally launched by the German trade associations for information technology (BITKOM), the electronics industry (ZVEI), and mechanical engineering (VDMA). Now, industry, associations, and politicians are working closely together under the leadership of the Federal Minister for Economic Affairs and Energy, Sigmar Gabriel, and the Federal Minister for Education and Research, Johanna Wanka. The aim is to create common standards and to advance Germany as an innovation and business location. The foundation of the platform's work takes place in various working groups. One of the first results is the Reference Architecture Model for Industry 4.0, which was created by the working group for reference architectures, standards and standardization under the leadership of Dr. Peter Adolphs, Managing Director/CTO at Pepperl+Fuchs.

Germany: Platform Industry 4.0

Industry plays a central role in the European economy: its share in economic output is 15 percent in the EU and 24 percent in Germany. It is, therefore, not surprising that companies in Germany created the term "Industry 4.0." With the high-tech strategy, the German Federal Government has thrown its weight behind Industry 4.0 as a project for the future in order to promote the country as a location for innovation. Platform Industry 4.0 has been launched and brings together representatives from politics, business, trade unions, and research. Working together, the platform aims to drive forward standardization and standards, increase the security of networked systems, clarify legal frameworks, and promote research and innovation. One of the first results to emerge from this work is the Reference Architecture Model for Industry 4.0 (RAMI 4.0). In contrast to the US model, which is closely linked to software development, RAMI 4.0 focuses on manufacturing.

Of all the developments surrounding the fourth industrial revolution, one must not be ignored: Industry 4.0 is currently still a research agenda. As such, the development of standards that apply to all regions is considered to be important. This is the only way in which a common path toward the fourth industrial revolution can be forged – because this development can only be undertaken on a global basis. ■

Industry 4.0:
From Research to Practice

© SmartFactory^{KL}

The world's first functional manufacturer-independent Industry 4.0 plant was completed in 2014 in the city of Kaiserslautern, Germany, and has since developed steadily. A team of researchers and developers – supported by numerous industry partners – is working there to achieve practical implementation of this widely discussed vision. Sensor technology plays an important role in the SmartFactory^{KL} demonstration systems.

How can the latest IT technology be used for industrial production? To find answers to this question, the technology initiative SmartFactory^{KL} e. V. was founded in 2005. One of the seven founding members included Pepperl+Fuchs. Head of the project, Professor Detlef Zühlke, leads the research field of innovative factory systems at the German Research Center for Artificial Intelligence GmbH (DFKI) in Kaiserslautern.

"At the DFKI, the thinking is visionary and research is carried out at a high level. With SmartFactory^{KL}, we wanted to take a step towards practical implementation in industry." This is how Professor Zühlke describes the division of labor between the two institutions. The first SmartFactory^{KL} demonstration was completed two years after it was founded. It was used to show a process from the chemical industry in which a customer-specific configured product was created – an individually filled soap bottle from batch size 1. »

© SmartFactory^{KL}

» USB Plug for Production

To ensure the smooth integration of communication and interfaces, common standards are essential. *SmartFactory^{KL}* has now defined these standards for components such as a plug that Professor Zühlke calls "our USB plug." It combines connections for operating current, compressed air, Ethernet, and an emergency stop circuit. Using this connector, the infrastructure boxes that provide the energy production process and a communication channel are connected in the latest *SmartFactory^{KL}* systems. The companies involved have developed different variants of these boxes. The standard connection makes them interchangeable. "Customers can compare the units and decide which one best meets their needs without any restrictions. Not only does standardization create technical consistency, it also opens up the competition in terms of technical and economic efficiency across the field level," explains Professor Zühlke.

The infrastructure boxes work as parts of the modules that make up the system. These modules are completely autonomous and function without any direct mechanical, electronic, or information technology connection to each other. If one of these is removed, the system works around the gap and uses the remaining options. If a module is added, the neighbors recognize the new addition by its RFID tag and integrate it into the process.

Sensory Key: RFID

"RFID is the only transmission technology that works with the reading and writing of product identification," explains Hicham El Menaouar, Sales Engineer at Pepperl+Fuchs. "It's an essential sensory key for Industry 4.0. What is crucial is that even in the case of strong interference, the signal emitted is absolutely reliable. It must be possible to insert the sensor into the communication architecture using a standardized interface, allowing a continuous stream of information to flow."

SmartFactory^{KL} and DFKI

The SmartFactory^{KL} e. V. technology initiative is a network of researchers and industrial companies carrying out joint projects with a view to the industrial production of the future. As a manufacturer-independent demonstration and research platform, it develops information and communication technologies in realistic industrial production environments.

The German Research Center for Artificial Intelligence – Deutsches Forschungszentrum für Künstliche Intelligenz GmbH (DFKI) – is the leading research institution in Germany in the field of innovative software technologies. Measured in terms of number of employees and volume of external funding, it is the world's largest research center in the field of artificial intelligence and its applications.

This consistency in the *SmartFactory*^{KL} plant is in principle fully comprehensive. An integrated ERP system ensures transparency and efficiency in the constantly changing process. Operational and product data from the production modules is captured, enriched, and structured using protocols such as OPC UA. A data monitoring system can set off an alarm or change certain parameters independently if necessary. A data hub connects the modules with each other and with the overarching IT systems. The individual modules can act either in parallel or autonomously – the production module sends its process data as tweets that are available worldwide via Twitter.

Cloud Communication

In principle, the demonstrator can also communicate in the cloud, but at the moment, there are only a few practical industrial applications for this capability. Yet intensive research is being carried out on this subject at the DFKI. A cloud connection for sensors and actuators has been developed as part of the App Pro project, including an industrial app store and suitable apps with which the field devices can be programmed.

"Industry 4.0 means that product life cycles continue to decrease. Hardware must then be reprogrammed every few months. The cloud app solution offers an easy way to achieve this," explains Professor Zühlke. ■

➡ **www.smartfactory-kl.de**

© *SmartFactory*^{KL}

Interview with Professor Detlef Zühlke

Head of the *SmartFactory*^{KL} technology initiative and the research field of innovative factory systems at the German Research Center for Artificial Intelligence (DFKI).

How would you classify SmartFactory^{KL} *on an international level?*
Our initiative is quite unique. In some countries, such as Korea, individual companies are working on concepts for the industry of the future. In the United States, there are consortia such as the Smart Manufacturing Leadership Council or the Industrial Internet Consortium (IIC). The IIC focuses more generally on Internet applications but does not carry out in-depth research into production. We are the only manufacturer-independent consortium equipped with its demonstrators that is working on a practical industrial level. And it is perhaps precisely for these reasons that two members of the IIC – Cisco and IBM – have joined us.

In what areas are the foundations being laid for the future?
Where the standards are set. From cables and plugs to transmission protocols and interoperability, standards that are as widely applicable as possible are required so that Industry 4.0 can work in practice. Above all else, what we need for a globally unrestricted flow of information is standardized signal packets or stacks for sensors, actuators, and drives. These are what will make real plug-and-produce a reality.

In the IT world, plug and play is already working. Can we not simply make use of that?
In the industrial environment, that is a much more complex task. We have a wide range of products that need to be classified for that purpose. There are positive approaches but there still remains a great deal of work to be done. Plug and produce that works well has far-reaching consequences for the providers – the products become interchangeable. Industry 4.0 is not only a question of technology.

Practical Experience at High Speed

© Delta Racing Mannheim electric e. V.

Right up until the last minute, things are being put into place, tested, and improved. The requirements are high, and the teams have put a year of hard work into their projects. Formula Student is more than just a motor race. The students have to compete with their concept away from the race course. Pepperl+Fuchs supports the students with products or by sponsoring their race cars.

The tension rises. Then the start signal sounds and they're off! The audience is cheering and the team is joining in the excitement. Now everything must go smoothly. The racers are working to defend their position in the world ranking. But unlike in Formula 1, other factors besides their performance in the race count in Formula Student: they need a great business plan and marketing, and the car has to run as efficiently as possible.

Formula Student is a worldwide construction competition between teams from different universities. The students have designed the race cars themselves over the last year. Each year they take part with a new model and team – a challenging task in which the students demonstrate their teamwork, technical expertise, and business understanding.

Photoelectric Sensors and Rotary Encoders for Formula Student

The students require material and financial support from sponsors to reach a good position in the world ranking with their race cars. In 2012, Pepperl+Fuchs initiated a collaboration with the Czech Technical University in Prague (CTU), which is still in place today. The students are given rotary encoders for the laboratories in which they test the internal combustion engines of the race cars. The scope of the collaboration has expanded over time: today, Pepperl+Fuchs is one of the main sponsors of the 30-person-strong CTU CarTech team.

Pepperl+Fuchs also supports various teams in Formula Student Germany (FSG), which has been hosted by the Association of German Engineers (VDI) since 2006. The company provides products such as photoelectric sensors and rotary encoders. From this season onward, Pepperl+Fuchs is also sponsoring the electric race car of the Delta Racing Team at the University of Mannheim, Germany, which competes in the separate Formula Student Electric class.

These collaborations allow the company to get in touch with students from different engineering disciplines and get them interested in Pepperl+Fuchs through Formula Student. The teams benefit from the extensive practical experience at the competition, allowing them to prove themselves. ■

EVENTS
2015/2016

11 November

Honeywell Users Group EMEA
November 16 – 19, 2015
Madrid, Spain

Yokogawa Users Conference, Asia Pacific
November 19 – 20, 2015
Singapore, Republic of Singapore

SPS IPC Drives
November 24 – 26, 2015
Hall 7A, Booth 330
Nuremberg, Germany

12 December
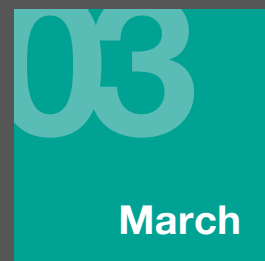
Measurement and Control Show
December 2 – 4, 2015
Tokyo, Japan

01 January

International Trade Fair of Automation & Mechatronic
January 27 – 29, 2016
Celje, Slovenia

03 March

CFIA
March 8 – 10, 2016
Rennes, France

04 April

HANNOVER MESSE
April 25 – 29, 2016
Hall 9, Booth D76
Hanover, Germany

www.pepperl-fuchs.com/events

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