PEPPERL+FUCHS

News for Factory Automation

2/2015

Blueprint for Industry 4.0

A clear path to the digitally networked future of industry and production systems is provided by the reference architecture model.

Hygienic and Innovative

The UMB800 ultrasonic sensor series with a stainless steel design meets the needs for applications with hygienic requirements.

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**

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Augmented Reality

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Focus

Blueprint for Industry 4.0

Even in a totally networked future, Industry 4.0 will have structures that define the functional units and regulate the data flow. The economic and research initiative "Platform Industry 4.0" has designed a model of these structures. It provides a clear path to the digitally networked future of industry and production systems.

Platform Industry 4.0 was originally launched by the German trade associations for information technology (BITKOM), electronics industry (ZVEI), and mechanical engineering (VDMA). Today, representatives from politics, industry, trade unions, and science are working on this initiative to provide recommendations for the development and implementation of Industry 4.0 concepts.

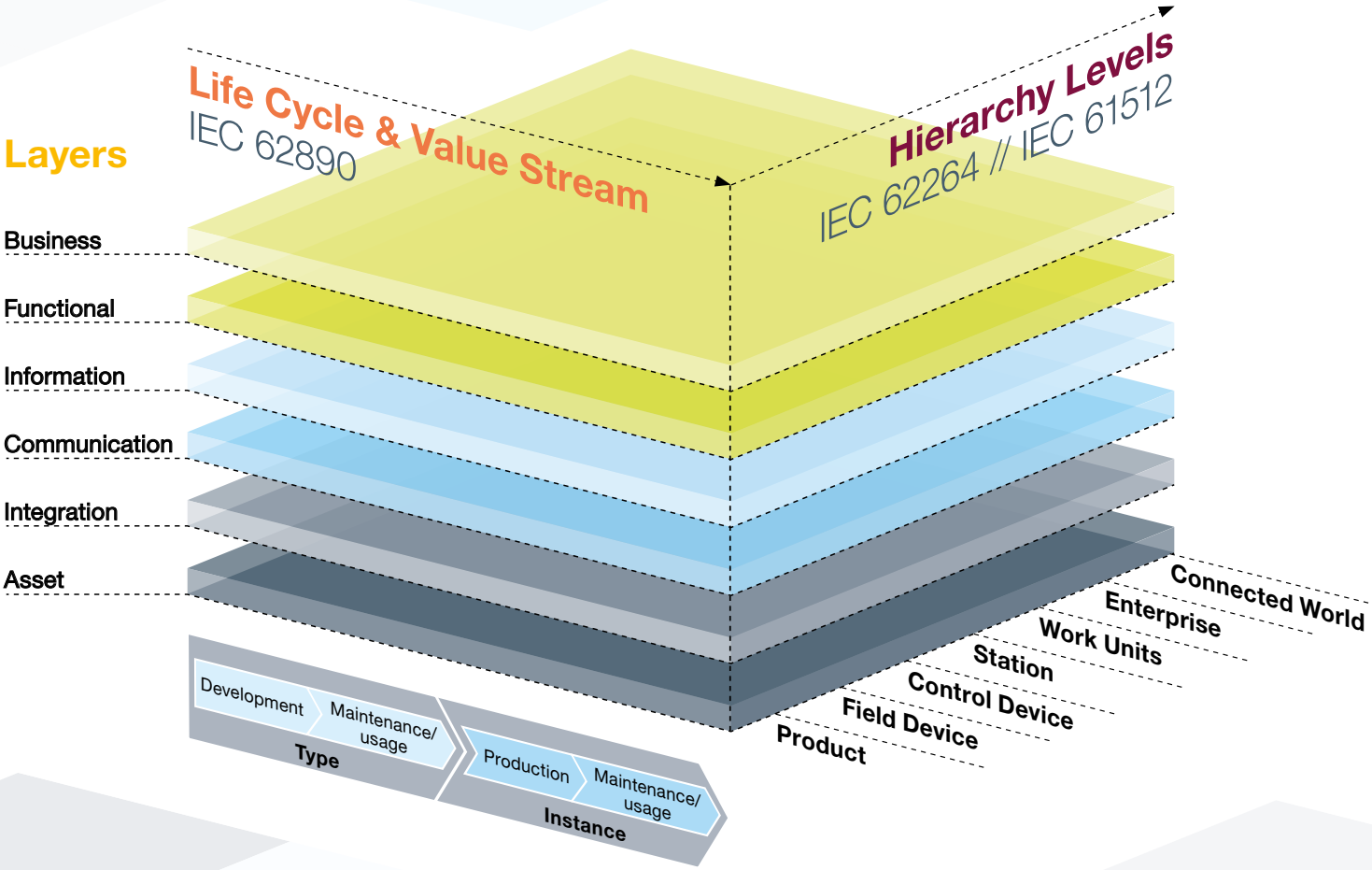
The working group on reference architectures, standards, and standardization – led by Dr. Peter Adolphs, Managing Director/CTO at Pepperl+Fuchs – deals with the need for a common understanding of Industry 4.0 technologies. The result is the reference architecture model for Industry 4.0 – referred to as RAMI 4.0. This model describes the communication between both simple components, such as field devices, and complete factories. It represents the essential aspects of Industry 4.0 in a three-dimensional coordinate system:

Hierarchy Levels
The first of the three axes, hierarchy levels, runs along the hierarchy levels from IEC 62264, the international series of standards on the integration of company computing and control systems.

Life Cycle & Value Stream
The second axis, life cycle and value stream, represents the life cycle of facilities and products. This is based on the IEC 62890 standard for life cycle management.

Layers
The third axis, layers, maps the information technology representation and delivers digital images – for example, of a machine or a system, in layers.

Together, the three axes produce a complete model of all essential aspects of Industry 4.0. The participants – a field device, a machine, or a system – can be logically classified in this model. RAMI 4.0 allows flexible Industry 4.0 concepts to be described and implemented. It is a type of 3-D map for Industry 4.0 solutions and acts as a guide for a stepwise migration.


Layers
Life Cycle & Value Stream
IEC 62890
Hierarchy Levels
IEC 62264 // IEC 61512
Business
Functional
Information
Communication
Integration
Asset
Development
Maintenance/ usage
Type
Production
Maintenance/ usage
Instance
Product
Field Device
Control Device
Station
Work Units
Enterprise
Connected World

An interview with Dr. Peter Adolphs, Managing Director/CTO at Pepperl+Fuchs and head of the working group on reference architectures, standards, and standardization of Platform Industry 4.0, which developed the RAMI 4.0 reference model.

Dr. Adolphs, why do we need a reference architecture?
We need a framework to ensure that the many efforts directed toward Industry 4.0 can be brought together in a way that makes sense. This framework can be used to define and assign specific tasks.

Can a German model for a globalized industry be valid?
Platform Industry 4.0 has close links to the United States and works together with the American initiatives. Of course, we want to find global solutions. The industry of the future cannot be confined within national borders.

How is the US-based reference model different?
The main difference between RAMI 4.0 and the American Industrial Internet Reference Architecture (IIRA), which is a few months younger, is that the German model is very clearly focused on industry. The American model goes far beyond this and includes aspects such as Smart Home or Smart Traffic.

Does that mean the Americans are one step ahead?
No, they have a completely different approach. In the USA, the assumption is that the new IT world will have a potentially infinite number of participants who use software to interact equally in the cloud. In the American model, the Smart Car always remains in the same “sphere” from production through maintenance to Smart Traffic. The Americans are very strong on the topic of resilience – in other words, answering the question of how we can ensure that the failure of individual components does not jeopardize the whole process.

What are the strengths of RAMI?
Our aim is the hierarchical production reality. A car manufactured in Industry 4.0 does not have to include all the production data for maintenance or Smart Traffic. We believe that different applications require different methods and prefer to think of defined handover points. I think that both models could complement each other very well.

Why does hierarchy make sense?
A sensor is a unit in itself, but it is also part of a machine or factory. This is a natural hierarchy. It is useful to both bring together measurement data and create a clear and organized way to access parameterization. For this reason, we have defined the administration shells in RAMI 4.0, which can be compared to the layers of an onion. End-to-end communication is possible, but data flow and access rights can be assigned to certain shells based on relevance, function, or the person using the access. This gives us clear structures and protection options.

What is the next step for Platform Industry 4.0?
We are just creating the basics for uniform semantics; in other words, a language that is understood by all participants. Simultaneously, we are compiling examples of use – use cases – to play through frequently occurring processes and to find viable rules.

How far are we from Industry 4.0?
A perfect form of Industry 4.0 will still take a while. It is coming, but in stages, not with a big bang. RAMI 4.0 should provide a significant contribution to a pragmatic migration strategy that will produce the first tangible results for us in the near future.

What might these results look like?
At the moment, if there is a sensor problem, I need access to the PLC to run a thorough diagnosis, which is not always possible. As soon as end-to-end communication is possible, I can communicate with the sensor directly to perform operations that may be required, such as re-parameterization. Using RAMI 4.0, the access rights can be very precisely limited, and optimum service and security for the system function can be accepted with no problems.

What does this mean for sensor manufacturers?
In the Internet of Things, the sensor will be the central supplier of information. The trend will be for future business models to be based on the function of the product and the data it can supply, not the product itself. Pepperl+Fuchs is therefore committed to engaging a lot of its resources in this area because we want to help shape this development. ■

Hygienic and Innovative

Ultrasonic Sensors **The UMB800 ultrasonic sensor series with a stainless steel design right down to the mounting fixture meets the needs for applications with hygienic requirements. It opens up previously impossible application areas in the pharmaceutical and food industries. The Ultrasonic Technology and Innovation Department at Pepperl+Fuchs uses new technological approaches to completely rethink sensor technology.**

Steam Jet-Resistant Sensor with Hygienic Design

Ultrasonic sensors are not affected by light reflections and reliably detect objects regardless of their color and transparency. However, sensors that come into direct contact with the product could not previously be used in hygienically sensitive plants in the food or pharmaceutical industry. The available devices were either unsuitable for hygienic reasons due to their standard design or would not have withstood the prescribed cleaning processes.

That is exactly what the new UMB800 series ultrasonic sensors can do. The housing of the first 18 mm ultrasonic sensor with an EHEDG-certified, fully stainless steel design is laser welded and hermetically sealed. This means that the sensors can be cleaned with steam jets and aggressive chemical techniques without any problems. The sensors can also withstand high operating temperatures up to +85°C. In addition to the EHEDG certification, the ultrasonic sensors, including the matching mounting fixture, are also approved by ECOLAB and the FDA. With its small housing dimensions and large detection area of 800 mm, the UMB800 series can be flexibly integrated into existing machines and systems.

Researching New Territory in Ultrasonic Technology

Advancing into new performance areas of ultrasonic sensor technology is the result of systematically driven innovation. The development of new technological approaches is the task of the Ultrasonic Technology and Innovation Department at Pepperl+Fuchs. Under the direction of Dr. Till Steiner, a group of engineers and students work on projects with the goal of finding new measuring principles for ultrasonic sensor technology. “A basic rule for ultrasonic transducers is that a large sensing range automatically comes with a larger blind zone – the area in which objects are not detected. We can minimize, but not fully resolve this dilemma by using conventional technology. Therefore, we try to forget the well-known solutions in this area and, in effect, reinvent the sensor,” explains Dr. Steiner. “One of our tasks is to think outside the box and to investigate some unorthodox approaches. Our technology roadmap ensures that practical concepts emerge from creative approaches, which our colleagues in product development transform into successful devices.” ■

www.pepperl-fuchs.com/news-umb800

The New Generation of Photoelectric Sensors

Photoelectric Sensors **The first two representatives of a new generation of photoelectric sensors: the brand-new R100 and R101 series combine multiple photoelectric features in a single design.**

R100 and R101 series photoelectric sensors enable continuous communication on the sensor level but take flexible integration and cutting-edge technology to the next level. What makes these sensors so special is that for each and every sensor in the portfolio – from the thru-beam sensor to the distance measuring sensor – each series has a single housing design. Having the same mounting and operation specifications for a wide variety of sensors means that you can easily exchange sensors in between different applications.

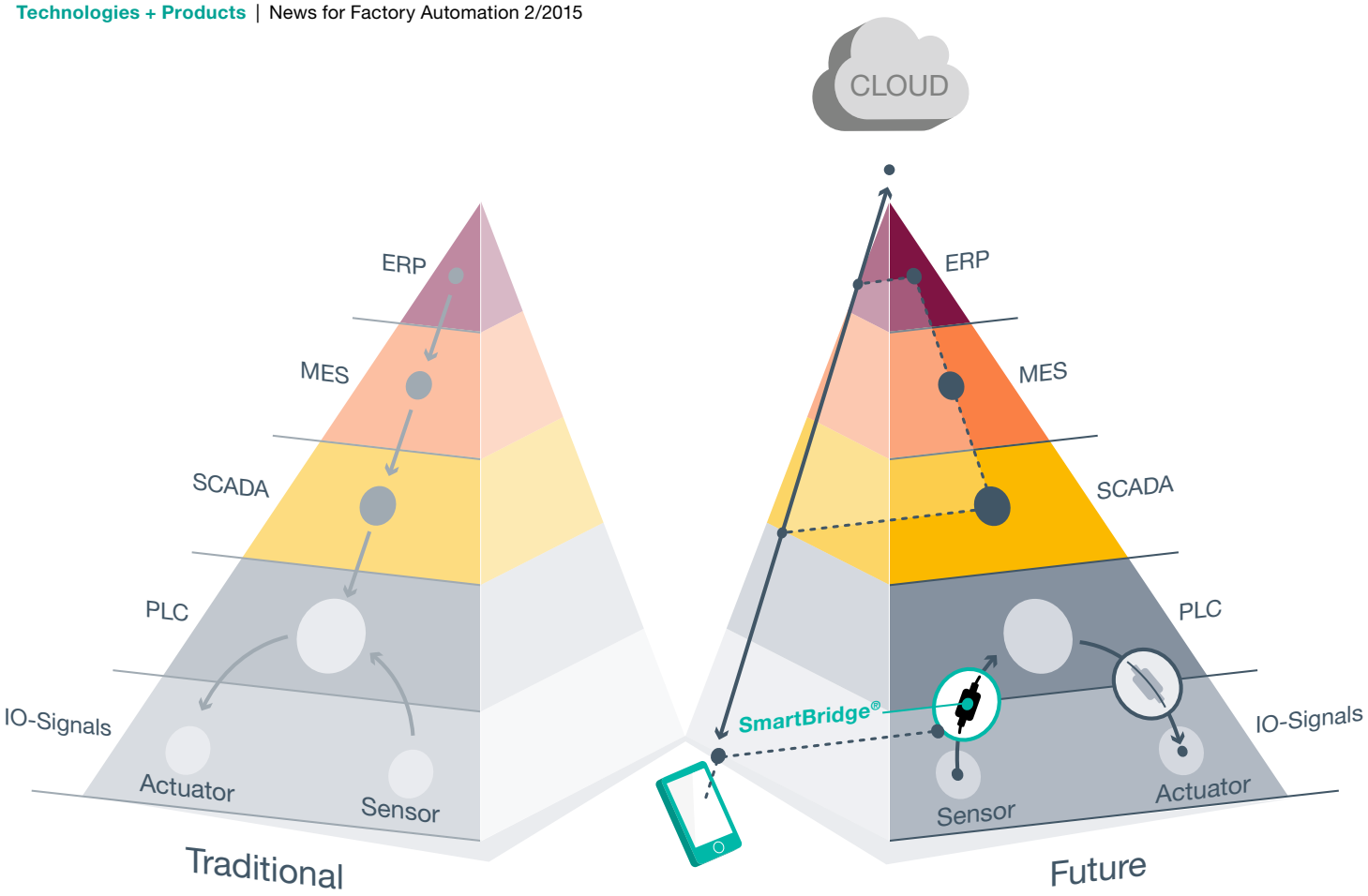
The future-oriented product architecture of the R100 and R101 series opens new possibilities for use and enables flexibility for meeting future challenges. Through the integrated IO-Link interface, the intelligence of these small sensors can be used to its full potential. IO-Link provides the basis for Sensorik 4.0, enabling continuous communication down to the sensor level. SmartBridge® technology can also be integrated easily via IO-Link. SmartBridge® allows you to program sensors and view sensor data using a mobile device.

New Laser Technology Combines the Advantages of LEDs and Laser Sensors

Both product families use Pepperl+Fuchs Multipixel Technology (MPT). This technology provides the user with new possibilities by using sensors with several switch points or even the smallest, compact IO-Link distance sensors. Maximum process reliability and precision in object detection at close range are guaranteed.

Another benefit of the new generation of photoelectric sensors is the possibility to choose between different functional principles and a variety of light sources. The sensors are available in laser as well as LED versions. The laser sensors are based on a completely new laser technology, and it combines the advantages of laser sensors with those of LEDs. This means that the sensors feature an extended temperature range and a significantly longer life cycle than conventional laser diodes. ■

www.pepperl-fuchs.com/news-r100-r101



Sensor Communication of the Future

Sensorik 4.0 **With the new SmartBridge® technology, Pepperl+Fuchs has taken a crucial step towards Industry 4.0. Along with the primary interface, SmartBridge® creates an additional wireless channel for the transfer of IO-Link sensor data – laying an important foundation for the sensor technology of the future.**

The SmartBridge® system consists of an IO-Link Bluetooth interface and an app for mobile devices. The interface accesses the digital signals of the sensor and sends the signals via Bluetooth to a mobile device or any other receiving device acting as a gateway to the Internet.

If the sensor is already communicating with the PLC via IO-Link, using the SmartBridge® app, the data exchange can be displayed on the mobile device. Using a conventional PLC or if not connected to the machine control, SmartBridge® acts as a master module. In this case, you can view process data and status data via the mobile device, and change sensor parameters. The necessary driver information is automatically downloaded from the Internet, and the sensor functions are displayed graphically or in tabular form.

User-Friendly and Innovative

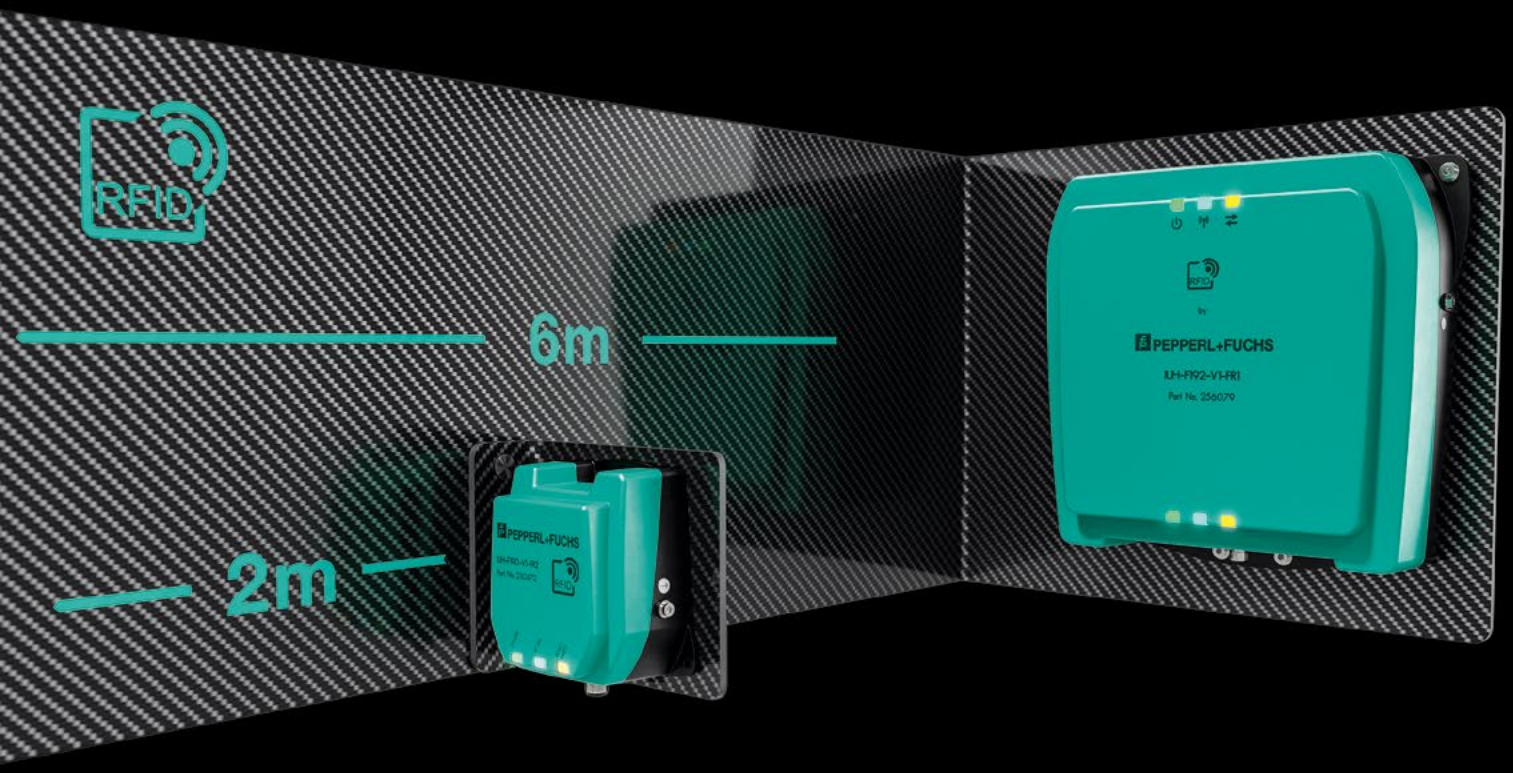
IO-Link sensors and actuators offer a wide variety of functions. In addition to intuitive operation, the SmartBridge® app offers other benefits for these intelligent devices. For example, pre-set parameters can be copied and transferred to identical terminal devices via SD card. For commissioning machines and plants, the technology helps to check and change the key operating parameters of the device more quickly.

Diagnostics is also much easier, as SmartBridge® can record functions over a long period of time in the same way as a data recorder. In particular, locating random failures is significantly faster.

If sensors or actuators are used in sensitive areas, it is useful to monitor limit values or notification thresholds at all times. SmartBridge® technology can constantly transmit process and status data from the IO-Link device to an external monitoring device in order to prevent interferences. ■

www.pepperl-fuchs.com/news-smartbridge

A Powerful Duo for Secure Tag Detection



RFID **Capable of functioning reliably even under harsh ambient conditions while remaining flexible: UHF read/write heads from Pepperl+Fuchs. The F192 now joins the product family with its outstanding properties.**

With a range of up to six meters, the F192 is particularly suitable for applications involving long distances, such as in logistics. It can read and write up to 200 tags simultaneously. This function enables a particularly fast throughput and increases productivity.

The F192 builds on the proven F190 UHF read/write head, which is optimized for applications involving medium-length detection ranges of up to 1.50 m. The F190 can read up to 40 tags in bulk and, with its compact housing design (11 x 11 cm), can be used virtually anywhere, thereby ensuring smooth and fast production processes.

Dual Polarization for Reliable Processes

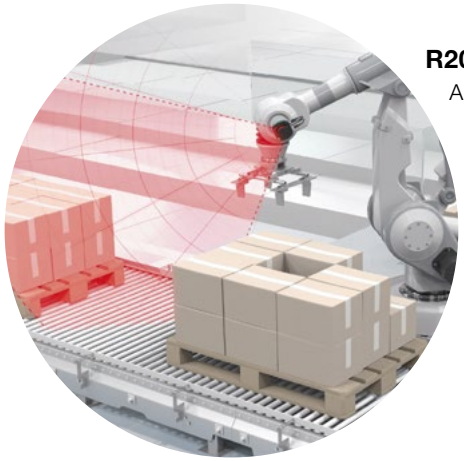
Whether in the automotive industry, intralogistics, or transportation – the UHF read/write heads function reliably even under difficult conditions and high temperatures. In addition, they are very flexible: the antenna polarization for secure tag detection can be manually set horizontally or vertically, or switched fully automatically for each read/write access, depending on the application.

Both devices have the IP67 degree of protection, a stable metal base, and embedded electronics. A further plus point is the possibility of enabling the read/write heads to be used in every country. The devices are provided with the respective country-specific parameters, such as maximum transmission power or used frequency bands. This feature simplifies system integration considerably. The highly visible LED display also facilitates status control in the field – even from long distances. ■

www.pepperl-fuchs.com/news-uhf

Series with 360° All-Round Field of View

Photoelectric Sensors **Complete 360° all-round visibility, a compact design, and precise detection of the smallest of objects – all impressive properties of the R2000 series.**

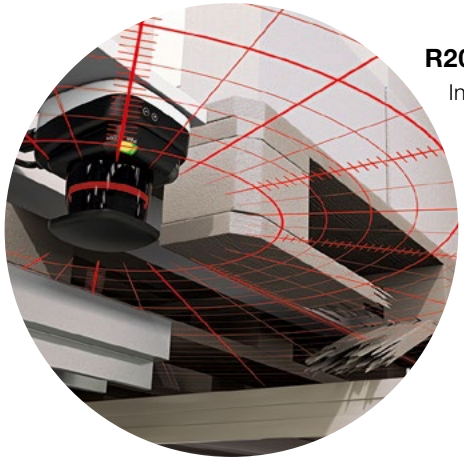


R2000 High Density – Contour Measurement and Object Localization

As a result of the complete all-round visibility and the resulting measuring angle of 360°, the R2000 HD (High Density) measuring sensor is optimized for object profiling and robotic applications. At ranges of up to 30 meters to a reflector and natural objects, the sensor provides superior measurement accuracy. With 84,000 scan points per second, as well as an angular resolution down to 0.043°, the sensor ensures high-precision contour measurement data.

R2000 Ultra High Density – for Navigation and Positioning

Automated guided vehicles must be navigated and positioned precisely. The R2000 UHD (Ultra High Density) has impressive speed and an exceptionally high resolution. A total of 250,000 scan points per second and angular resolution of 0.014° perform high-precision positioning tasks. As an infrared laser version, the R2000 UHD offers a range of up to 100 m. In addition to exact distance and angle measurement, the R2000 UHD provides information about the reflectivity of objects. As a result, reflectors can be differentiated from natural objects.



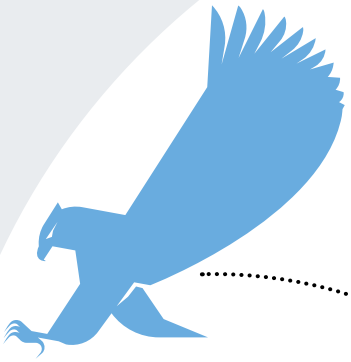
R2000 Detection – the All-Rounder for Detection and Monitoring Tasks

In high-bay warehouses, protruding parts or damaged pallets can collide with the stacker crane and cause major damage to expensive machinery. In this case, the R2000 Detection reliably detects even the smallest overhangs that might damage pallets. The switching sensor has four freely definable detection fields, which can be logically linked with the outputs in virtually any way. This step is performed using a device type manager (DTM). This user interface visualizes configuration, parameter, and diagnostics data. As an infrared laser version, the R2000 Detection allows you to monitor with a radius of up to 30 m to natural objects.

www.pepperl-fuchs.com/news-r2000

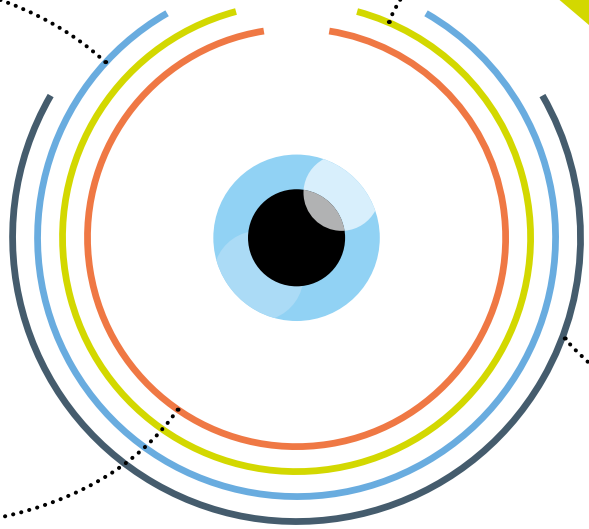
The 2-D laser scanners provide accurate measurement results under the most difficult conditions and can easily be integrated into the application in a way that saves space. With Pulse Ranging Technology (PRT), the sensors have short response times. Negative influences such as ambient light cannot affect the function of the sensor. Basic adjustments can be made directly on the device, and operating and diagnostic information can be displayed during operation. The series consists of several versions: the R2000 Ultra High Density (UHD) and R2000 High Density (HD) measuring sensors, as well as the R2000 Detection switching sensor. ■

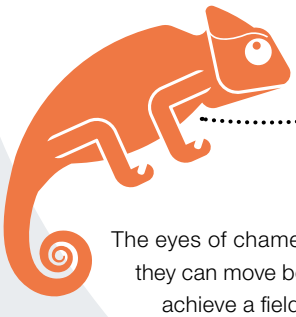
All-Round Visibility in Nature



With his sharp eyes, the kestrel can find its prey easily. It can see the environment clearly and finds its prey by using a field of vision with fixation of around 300°.

Frogs possess an impressive field of vision with fixation of around 330°. This is possible because the frog's eyes are located on the sides of its head.





The eyes of chameleons are also highly developed: they can move both eyes independently and hereby achieve a field of vision with eye rotation of about 342°.

Compared to that, the human's field of vision with fixation is about 180°; the field of vision with eye rotation is about 240°.

Although no known living creature has a complete 360° all-round visibility, the visual abilities of some animals come close.

To describe the area in which living creatures can see, there needs to be a distinction made between the field of vision with fixation and the field of vision with eye rotation.

The field of vision with fixation is what we can see when we look straight ahead with our head held straight; one point is fixated at a motionless glance. It is not important if we can see the objects clearly or not. In contrast to that, the field of vision with eye rotation describes the area in which we can see clearly – with both rotating the eyes and fixating on different objects.

Reliable Sensors for Premium Brands

Pepperl+Fuchs sensor technology enjoys a strong presence in the production facilities of automotive manufacturers worldwide. The devices play a crucial role in complex production processes by providing exact positioning signals as part of the intricate coordination of mass production and customized operations. The body assembly line of an international automotive manufacturer is one example of where such devices are used.

Space is limited at the production facilities of most automotive manufacturers. Production areas can only grow vertically, as it is not uncommon for production lines to be up to 50 m in height. The auto body distribution center is similar to an oversized high-bay warehouse: hundreds of vehicle bodies can be accommodated on multiple floors. The vehicle bodies are fastened to metal sleds, otherwise known as "skids," which travel back and forth on a motorized rail system. Transverse shuttles also allow lateral movement. This means that the vehicle bodies can be arranged in a flexible manner in order to operate the production lines on an order-by-order basis.

Pepperl+Fuchs inductive proximity switches from the L2 series can be seen operating on almost all of the rails and transverse shuttles. These switches detect the respective position of the skids without touching them. At the end of the rail, additional L2 series sensors ensure that the skids move slowly and detect the stopping position before entering the next assembly position. The L2 offers unique strengths. The device is very easy and flexible to install; with four corner LEDs, it is the first device of its kind to enable monitoring of the operating status and switching status from every angle. The L2 is also robust, moisture-resistant due to a high degree of protection (IP69K), and can be used at an ambient temperature of up to 85°C – a real advantage when the heat builds up under the plant roof in the hot summer months.

1) The VDM100 series distance sensor transmits laser pulses to a reflector below the lift using Pulse Ranging Technology (PRT). At the same time, the emitter on the LS680 optical data coupler emits the data to the receiver unit on the lift via Fast Ethernet.

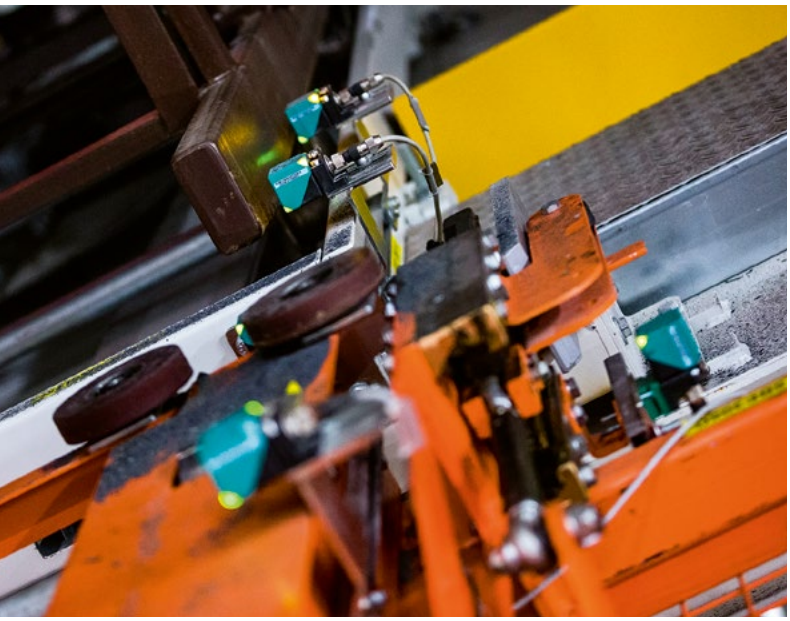
2) At the entrance to the lift, the inductive sensors detect the exact position of the skids, detect whether the lift can accept a car body, and ensure secure locking.

3) The skids are automatically transported from one workspace to the next via a rail system. During this process, the PCV Data Matrix Positioning System from Pepperl+Fuchs ensures precise positioning of the transverse shuttle.

Lightning-Speed Position Detection on the Car Body Elevator

It becomes especially hot at the top of the vertical shafts that are used to move the car bodies between the floors using lifts. A dozen inductive sensors from the L2 series are installed in the lift, which is like an oversized elevator for cars. These devices detect whether the path to the lift is free for the skid and are used to check if the car body is present and in the correct position. As soon as the skid and car body are correctly positioned on the lift, a secure lock is triggered by the inductive sensors. With the lift capable of moving up and down at a speed of up to two meters per second, the L2 inductive sensor function ensures fast, reliable distribution of the bodies, with virtually no interruptions. The lifts are supplied with inductive power. Furthermore, the transfer of data between the distance measuring equipment and frequency converter can be accomplished without wiring as a result of two intelligent optical data couplers from Pepperl+Fuchs.

A VDM100 series distance sensor is installed at the bottom of each lift shaft. This sensor transmits high-frequency laser pulses that are redirected off a mirror to the reflector below the lift. The deviation mirror prevents dust and dirt from building up on the lens of the device. The VDM100 uses the innovative Pulse Ranging Technology (PRT) to calculate the distance to the reflector using time-of-flight technology and the reflected light pulses. This signal can be used to determine the position of the lift with absolute accuracy. Communication between the VDM100 distance sensor and the higher-level host takes place via the LS680 optical data coupler. The LS680 transmission unit is mounted at the bottom of the lift shaft and transmits data to the receiver unit, which is installed directly on the lift. With the full Fast Ethernet bandwidth of 100 Mbit/s, the optical data coupler transmits the distance data to the motor host at lightning speed. The customer has opted for these devices because they are extremely reliable and require virtually no maintenance. The alternative would be at least three position switches in the shaft for each floor; this would lead to considerable problems in terms of accessibility and maintenance, not to mention the complex wiring required. However, given the vast cycle times of major automotive manufacturers, reliable and feasible solutions are key. The automotive manufacturer summarizes the advantages: "Pepperl+Fuchs laser technology equates to a quantum leap in lift positioning and in the speed at which the lift is moved."

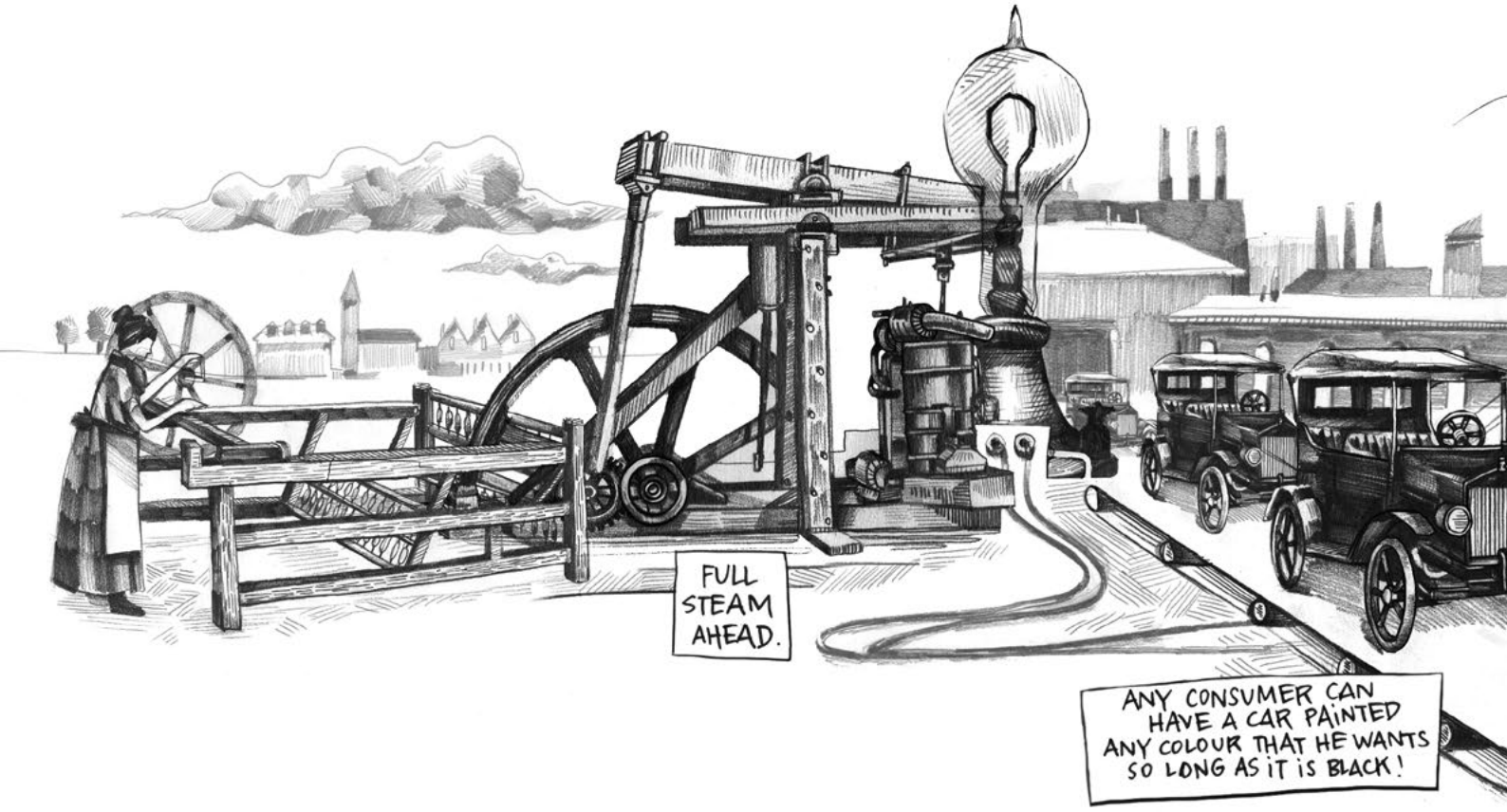


Exact Positioning for Paint Finishing

Work involving specialized painting and complex contours is less intense than the work carried out in the bodywork distribution center. There are fewer units to process in the department responsible for these tasks; a lot of the work is done by hand. The painted bodies are automatically transported from one workspace to the next via a rail-mounted transfer shuttle. During this process, the PCV Data Matrix Positioning System from Pepperl+Fuchs ensures precise shuttle positioning. An optical read head uses a self-adhesive data matrix code band affixed to the cross beam to detect the position markers and control the skid position to 0.1 mm accuracy.

Even more important in this context is the matter of reliability and data security. The PCV's wide scan window allows continuous positional feedback even if multiple code squares are missing. It collects at least six code squares in its image field; however, for an accurate scan, it only requires one. It can seamlessly traverse gaps created by monorail diverters and expansion joints, or accidental physical damage. The Data Matrix Positioning System is also impressive when it comes to handling: "The commissioning was really simple," a customer said. "After the installation, we only had to switch it on, and everything went as planned. Because there are no moving parts, there is also virtually no wear, and minimal maintenance is required. It is also very easy to operate and the host is extremely stable." ■

The Fourth Industrial Revolution Is Driving the World Forward



First Industrial Revolution

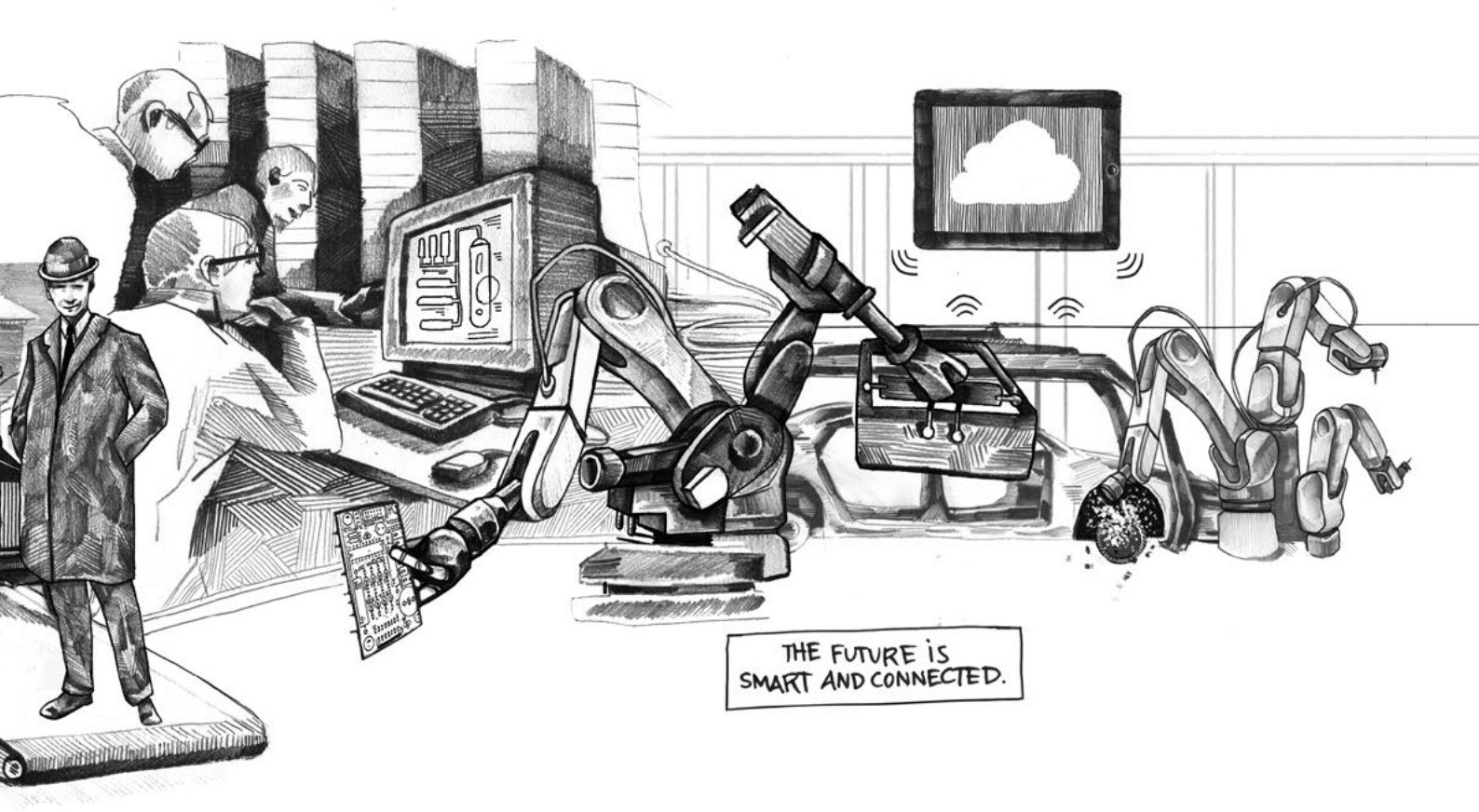
End of the 18th century

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.



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

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. ■

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.

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

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

12 December

Manufacturing Indonesia
December, 2 – 5, 2015
Hall C, Booth C-7521
Jakarta, Indonesia

01 January

SEPEM Industries NORD-OUEST
January 26 – 28, 2016
Hall 2, Booth A6
Rouen, France

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

03 March

LogiMAT
March 8 – 10, 2016
Hall 3, Booth 3C10
Stuttgart, Germany

CFIA
March 8 – 10, 2016
Rennes, France

04 April

Drives & Controls
April 12 – 14, 2016
Booth G150
Birmingham, Great Britain

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

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