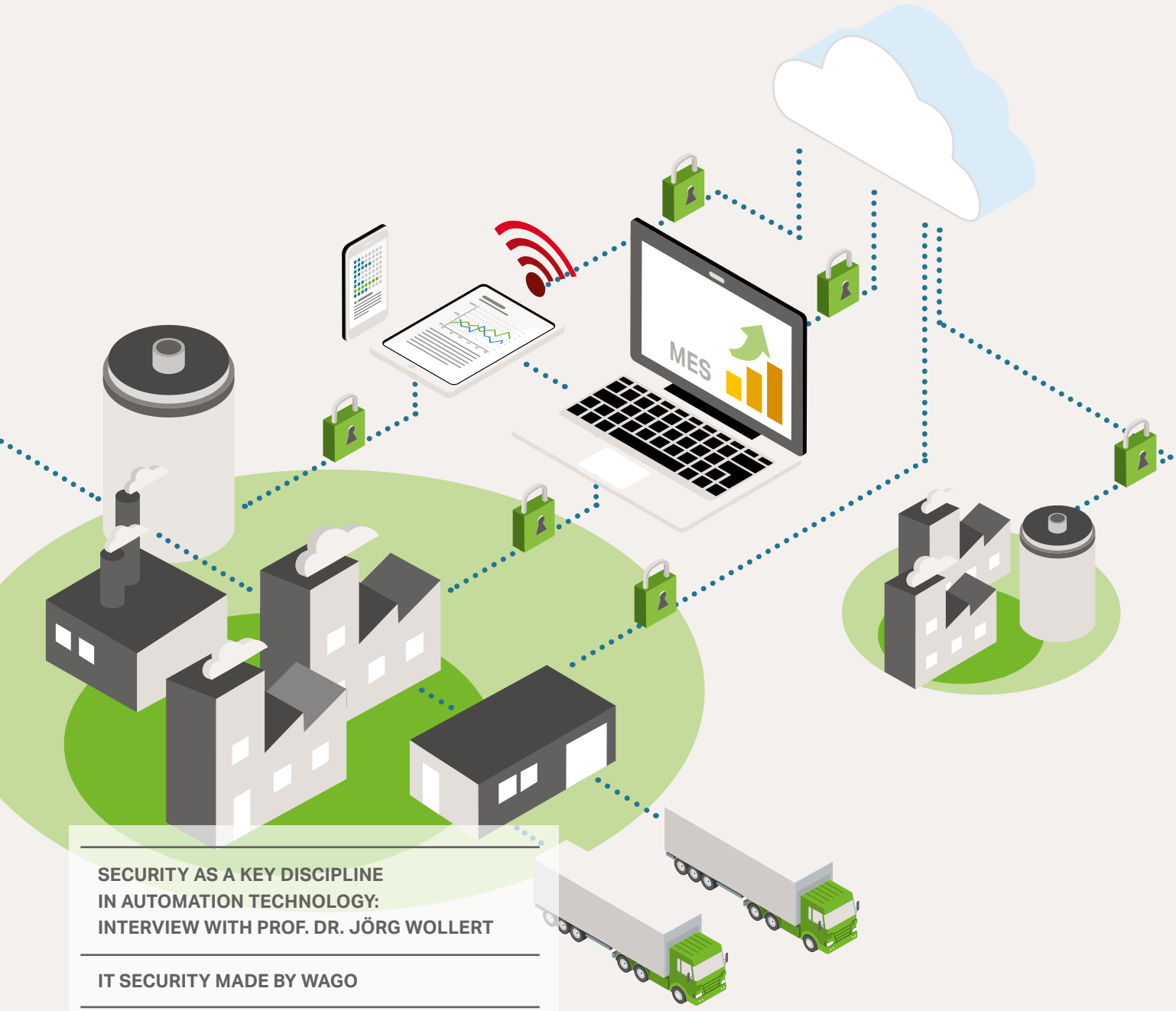
DIRECTINDUSTRY

On the road to the Smart Factory

Measure First, Then Manage



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- High-performance controller with integrated 3G modem and standard Mini-SIM card
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EDITORIAL
Measure in order to Manage

Dear Reader,

Imagine you were placing an order online. You select the desired item, for example, a dress shirt. You have configured it suitably, are satisfied with your selection, and now want to place your order. However, when you click the order button, a surprising text message appears: "Thank you for your request. The delivery time and price of your order are being calculated; we will send you an offer in the next few days!"
You would probably immediately select another online merchant, right?

Now, it is fairly certain that this type of blunder would never happen to an online merchant. After all, online merchants are distributors, not producers, and generally only offer items that are already available in stock. However, if you were to order from the manufacturer and the scenario played out as described; wouldn't you still want to switch manufacturers? Consider it carefully – which merchant offers what under what circumstances? Would you take a look at a manufacturer, who requires a few days as a producer to calculate and handle your individual configuration? I believe that you would do so only in extreme circumstances.

In the age of online shopping, global networking and availability, we expect statements about prices and delivery at our fingertips. In order to be able to implement this with respect to the production of goods requires direct access to manufacturing schedules, calculations, and even processes. Therefore, production processes must be designed more transparently in the future than they are today. This is because in order to make statements about production, or be able to direct it, measurement data from the production process are the first, elementary building blocks. The essential cornerstones of a transparent, adaptable and intelligent factory are therefore sensors, modular automation, networking inside of and outside of production, and IT security for all internal and external data flows.

WAGO provides a scaleable and modular product portfolio for these demands: the WAGO-I/O-SYSTEM 750 has more than 500 I/O modules, 60 controllers, and 40 fieldbus connections, which record and process practically every signal from the field level. When communicating data from the field level of a system into the internal production control or an external cloud application, embedded solutions offer a maximum level of integrated security mechanisms, like VPN, SSL/ TLS, and IPsec. The present **WAGO DIRECT**INDUSTRY offers you a first impression about the performance of WAGO automation – for an in depth introduction, we remain at your service.

Best regards,

Ulrich Hempen

COVER STORY

On the road to the Smart Factory

Networked, intelligent, autonomous, self-optimizing, and resource-efficient production is the central scenario of Industry 4.0 – the Smart Factory. Despite the alleged advantages that Industry 4.0 production appears to offer, questions remain for many companies, such as: why is it even necessary? what level of their own production must attain 4.0? and what steps should be the first on their path to the Smart Factory?

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Andreas Heyde (Ledvance) explains how savings potentials can be determined using the mobile measuring suitcase.

Success for the WAGO Roadshow

THINKING AHEAD ABOUT ENERGY MANAGEMENT

In September and October, WAGO invited visitors in eight German cities to its second energy management roadshow. The goal of the event, which was completely sold out, was to inform customers and other interested parties about possibilities for expanding energy management systems in ways that would be tailored to their companies.

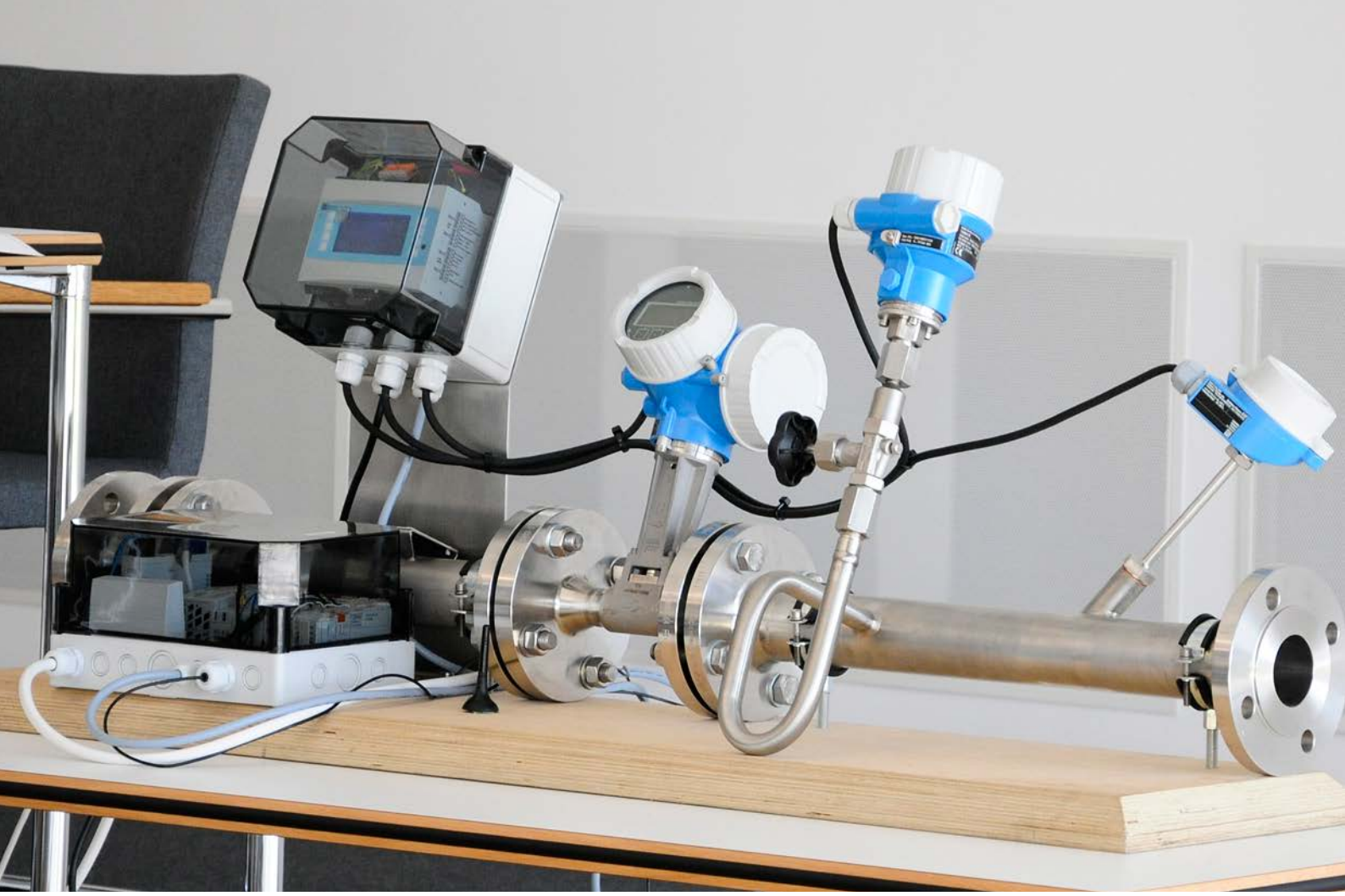

BOSCH

»If you aren't measuring it, you can't improve it.«

In early September, the Federal Cabinet determined the budget for the Federal Ministry for Economic Affairs and Energy (BMWi) for 2017. One third (2.443 billion euros) of the total budget of 7.432 billion euros is to be invested in the areas of sustainability and energy. Around 41 million euros are targeted for measures to increase energy efficiency, and 110 million euros are directed towards research into the areas of energy efficiency and renewable energies. These numbers significantly underscore the absolute relevance of the topic. WAGO began their second energy management roadshow at almost the exact same time. The company from Minden issues invitations for their Fall informational event, titled "Thinking Ahead about Energy Management". The event excited great interest, especially against a background of constant developments in legal requirements and technology. Experts held seven lectures on a single day, explaining which requirements are important for whom, where potential savings may be found, and which systems may be used to easily and inexpensively record and visualize all relevant data.

Patrick Paschke H&R Ölwerke Schindler, Hamburg

"I am responsible for optimizing energy management in all sectors of the oil refinery, from the process technology up to the building. At the moment, we have a few new construction projects and retrofits in the queue, and it would be a natural fit to set up an intelligent energy recording system from the very beginning. We have already used WAGO couplers; now I would like to learn which other products would make sense in our plans."



The throughflow complete measurement path from Endress+Hauser records different signals, like compressed air and temperature. These can be easily linked to the WAGO PFC200 Controller and transmitted to the cloud.

Components for an Energy Monitoring System Tailored to a Company

Production facilities and buildings are increasingly examined with respect to their efficiency. "The conditions, requirements, and goals are as varied as the companies themselves," explains Stefan Kretzschmar of Endress+Hauser, an instrumentation production company. In his presentation, he explained that a demand-driven energy management system not only provides savings potentials, but can also contribute to a competitive advantage.

"The structure for this type of energy monitoring system differs from company to company," according to Kretzschmar. They have different reasons for monitoring: One may require data recording; another is concerned about internal accounting; and yet another uses their energy data as a basis for cost calculations, for benchmarking purposes, or to apply for tax relief according to ISO 50001. The basis for identifying savings potentials lies in the precise monitoring of all buildings and machines associated with the operation. The adage, "If you aren't measuring it, you can't improve it", applies

André Meyer, Sonepar, Hannover

"For me, the PFC200 Controller is particularly interesting, because you can record and process different analog and digital signals with it. That means that you can individually design an energy management system with no programming knowledge."

Wolfgang Fischer,
Nord West Business Consult GmbH, Jever

"Last year, we were able to implement a successful project for a client in the logistics sector. An intelligent lighting system was installed in a climate-controlled space that covers 75,000 m². We used WAGO products almost exclusively. A total of 340 LED spotlights, which only light up when someone is working there, generate lighting areas that are 10 meters across. The customer was thus able to reduce his energy costs for lighting by one-third. I am convinced that there will be increasing demand for concepts that use energy more efficiently. So I am especially interested in what the possibilities for this are right now."

quite specifically here. Thus, all relevant media, for example, gas, electricity, or heat and their associated parameters, must be initially defined in a measurement concept. Energy data recording can then be initiated in a first step by using the appropriate measuring technology.

WAGO Energy Data Collection without Programming

In order to configure the monitoring of consumables as easily as possible, WAGO developed software for energy data collection that requires no programming knowledge. A PFC200 Controller is used, and various I/O modules are connected in series. "Customers can flexibly connect and record a variety of signals to the fieldbus-independent I/O system, according their needs," explains Lukas Dökel, an expert in energy management for industry and process technology at WAGO. Inputs and outputs can be parameterized and calibrated according to individual company requirements. All measurement signals, for example, regarding electricity, water, and compressed air, are transmitted by digital or analog sensors to the controller via the inputs in the I/O system. The Linux® based PFC200 Controller transmits the data to a server or the cloud via a secure connection. Thanks to the flexibly applicable Linux® software, all data can be

»Customers can flexibly connect and record a variety of signals at the fieldbus-independent I/O system, according their needs.«

Large levels of interest: all seats at the information presentations were completely booked.

comprehensively visualized to provide transparency in energy flows from start to finish.

Energy Management in the Cloud

Increasingly large amounts of data and the broader spectrum of documentation of energy consumers proves that digitalization has also finally achieved incorporation in energy management in production and buildings. Thomas Gaus, head of System Solutions Cloud at M&M, a software service provider, provided a view to the future of Industry 4.0 and the "Industrial Internet of Things" (IIoT), when he explained the advantages of cloud computing in his presentation on energy management, "There are different cloud services for every need. These extend from pure infrastructure provision up to complete solutions, for which even proprietary servers are not necessary." One essential advantage of the cloud lies in that users only pay for the services that they use. A cloud system can be configured according to specific desires. At the same time, data stored in the cloud are actually on three different servers and virtually cannot get lost. The modular WAGO energy data collection system can also be linked to cloud systems. Locations and controllers are set up using web-based user interfaces. The measurement data can then be transmitted by the controller to the cloud, and displayed and monitored in the dashboard.

Manfred Meyer, Stadtwerke Rotenburg (Wümme), Rotenburg (Wümme)

"As the head technician at the municipal swimming pool, energy efficiency is an important topic. Savings potentials are particularly interesting, as well as new trends in the areas of measuring and control technology. We have already automated the lighting control in the entries to the swimming pool. In the future, I would like to automatically control the energy management for the entire building and pool."

Intelligent Measurement in the Smart Factory

Andreas Heyde and Frank Blase from the OSRAM subsidiary LEDVANCE have developed an innovative solution for a first potential analysis with their team. In the meantime, their carry-on sized, mobile measurement suitcase is enjoying great demand outside of their company as well. A WAGO-I/O-SYSTEM 750 is installed in the suitcase. This can be coupled to various modules and and can record practically any digital or analog signal. The great advantage: process operation does not have to be interrupted during measurements. The measurements uncover savings potentials and provide important information about the state of the systems. All details can be reproduced using the depiction in the WebVisu app. Only when it has been demonstrated that real savings can be achieved by subsequent monitoring is a permanent measurement system installed. For Blase and Heyde, energy management plays a central role, particularly in the Smart Factory. Their system documents production efficiency linked to the site in realtime and can thus quickly identify and signal maintenance

Patrick Gellert, WESA GmbH, Waren (Müritz)

"I'm quite pleased with the modular data recording from WAGO. Inputs and outputs can be easily parameterized. This makes things easier for those of us who work in control cabinet design, so we can create transparent solutions for our customers without incurring programming costs."

Second stop: Hamburg, where around 60 participants learned about current trends in energy management with a beautiful view as their backdrop.

necessities and under utilization of specific machines. At the moment, the two are already working on an expansion of the system in order to minimize production interruptions. In the future, faults will be automatically recognized, or will not even occur due to early maintenance.

Guests and speakers at the roadshow were unanimous that energy management will continue to develop in the short term due to many innovations and regulations. “At the roadshow, we have already seen visionary solution sets for efficient energy monitoring. How the individual visitors will deal with the upcoming demands remains exciting,” stated Lukas Dökel at the conclusion of the presentation.

TEXT JULIA GROBE | WAGO

PHOTO WAGO

Volker Schaelicke, Schaelicke E-Service, Rellingen

“We support primarily small and medium-sized companies in electrical wiring, installations, and IT. It is important for us to know what demands will affect our customers in the future with respect to energy management so that we can offer them solutions as needed.”

Measuring and managing energy data

MEASURING SYSTEM WITH ADDED VALUE

The new “WAGO Energy Data Management” offers a convenient solution for recording and managing energy data – completely without programming expense and retrofittable at any time.

Corporate opinion is aligning increasingly along the axis of efficiency for buildings and systems. On the one hand, legal regulations require this; on the other, potential savings, which could ultimately bring decisive competitive advantages, also appear enticing. The level of potential savings can only be determined, however, once all types of energy and their consumers are systematically recorded and the data are viewed in the appropriate context. The foundation for all of this is, obviously, a good measuring system.

Practically speaking, however, this has often proven quite difficult. Because in order to construct transparency across energy types, the different measurement data have to be combined into a single system. The measurement solution usually has to be tailored to the situation, and is also extremely complex. In addition to defining the individual measurement points, selecting suitable measuring devices, counters and sensors, and then installing them, the programming of the measuring system is probably the most complex and time consuming, which leads to high costs. Then, when the measuring system finally runs, it quickly collects mountains of data, which then have to be dealt with.

Modular Collection of Energy and Process Data

A suitable measuring system must satisfy three criteria: it must be easy to integrate into the system, operate at very low cost, and it must ensure simple processing of the data it collects. This is exactly the solution offered by the new “WAGO Energy Data Management”. Due to a combination of predefined hardware and user-friendly software, the measuring system can be easily integrated into both systems and building technologies. The distinctive feature: in addition to energy-specific values, like electrical currents or voltages, many other measurement values can also be recorded that are relevant for industrial and process technologies or for building applications. Current, gas, heat, water, compressed air, and temperature are examples of data that occur together in one system. Recording them

enables a comprehensive view into the energy flows as well as into individual production processes at a company.

On the hardware side, the WAGO PFC200 Controller and the WAGO-I/O-SYSTEM 750 form the foundation. The modular structure enables individual adaptation to respective circumstances. For recording consumption that is device- or process-specific, a number of I/O modules are connected in series to the controllers, including, for example: 3-phase power measurement Modules for energy consumption measurements, pulse counters, interfaces for linking M-bus counters, for radio-based EnOcean sensors, and numerous other modules for recording analog and digital current and voltage signals.

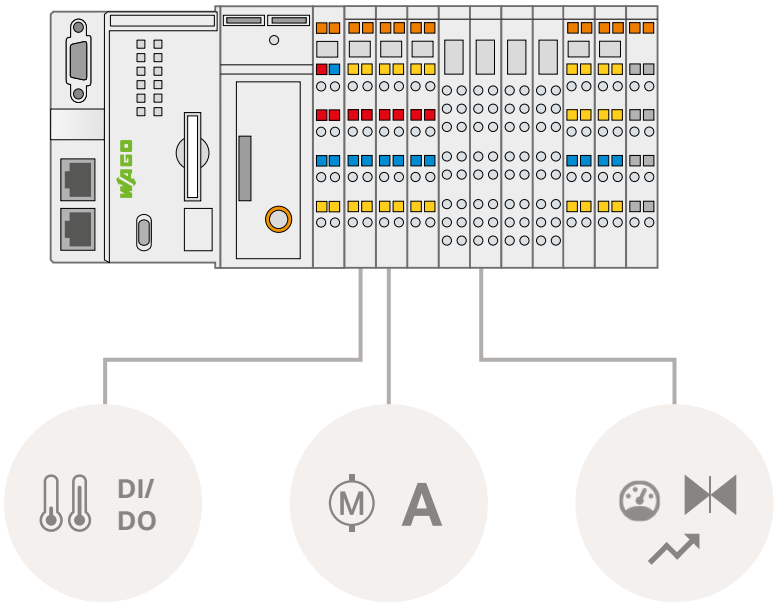
Modern Software

It is the associated software application that establishes the WAGO Energy Data Management as a powerful and user-friendly solution. This is loaded on the controller and automatically detects the connected I/O modules at start up. The inputs for data recording are adjusted via simple parameterization. All settings, for commissioning and during operation, can be carried out with the click of a mouse. No programming is required. Since the graphic user interface can be accessed by any standard browser, there is no need for local software installation. The web visualization configures the task in an especially convenient way.

Forwarding the data to higher level energy management software is carried out via Modbus TCP/IP or as a CSV file via FTPS. In addition, it is possible to save the history on an SD card. The easy and flexible connectivity of the new WAGO solution to existing infrastructures and management systems enables companies with extant energy management to increase the comprehensiveness of their measuring points in a simple way.

Visualization is Included

Different evaluations can be generated using the integrated visualization tool, which provides various types of diagrams and representations for visualizing the data. Companies can thus generate consumption curves, synchronized to their power company (PSC) or determine which consumers are responsible for peak loads by using the second-by-second display. In addition, the energy use can be observed as a function of specific process adaptations, for example, to determine how much energy would be saved by using variable speed motors, new lighting means, or by reducing leaks in the compressed air system. The WAGO Energy Data Management is thus also suited for those corporations that are only starting energy monitoring or who would like to work on the problem without a higher level energy management software product.



On the hardware side, the WAGO PFC200 Controller and the WAGO-I/O-SYSTEM 750 form the foundation. The modular structure enables individual adaptation to respective circumstances.

Advantages of WAGO Energy Data Management

- Modular recording of energy and process data
- Easy parameterization of inputs using web visualization – no programming needed
- Connect existing sensors to the WAGO-I/O-SYSTEM
- Integrated visualization
- Energy data evaluation and derivation of efficiency measures
- Establish indicators to achieve DIN EN ISO 50001

High Savings Potential for Industry

Energy monitoring is worth it, primarily for industrial companies, as can be seen by looking at the numbers. According to the energy efficiency sector monitoring of the German Industry Initiative for Energy Efficiency (DENEFF), German industry consumed a total of 2508 petajoules in 2014. That is just under one-third of the entire energy consumption of the country. Almost 65% of that was used to generate process heat. According to the German Energy Agency (DENA), approximately 15% of that energy could have been saved. The proportion of electrical energy used for process heating is rather marginal; however, electricity is gaining significant importance in the industrial energy mix. Today, industrial operations consume almost half, that is around 45%, of the electrical energy consumed in Germany. The Federal Environmental Agency estimates the savings potential in this case to be around 20%. These statistics make it clear: successfully transitioning to greater energy efficiency depends heavily on industry.

In order to achieve greater energy efficiency, companies in Germany have been obligated, starting in 2015, to carry out regular energy audits or to introduce energy management. The new WAGO Energy Data Management offers an optimal foundation for both. In order that measurement results are ultimately meaningful, however, companies must consider them in the context of so-called energy performance indicators (EnPIs), as well as other relevant operational data. The individual evaluation provides new information in each phase of the energy management regarding savings potentials in the company.

TEXT JULIA OCKENGA, LUKAS DÖKEL | WAGO

PHOTO Fotolia.com, WAGO

In addition to energy-specific values, many other variables can be recorded using the new WAGO solution: for example, current, gas, heat, water, compressed air, and temperature. All settings for data recording and processing are carried out using the graphic user interface – no programming required!

„THE OPTIMIZATION OF PRODUCTION PROCESSES PROVIDES A GREAT OPPORTUNITY"

Thomas Holm has been involved with the optimization of production processes in "Market Management Industry & Process" at WAGO since 2015, and is a leading participant in developing the DIMA concept (Decentralized Intelligence for Modular Applications). In the interview, Holm spoke about the opportunities that Industry 4.0 provides to mid-sized companies and offers insights into the corporate practices at WAGO.

Many experts feel that mid-sized German companies are lagging far behind when it comes to implementing Industry 4.0. Why is that, in your opinion?

» Implementing Industry 4.0 means a comprehensive change in the accustomed business model for the corporation, in addition to the incorporation of the technologies used. This results in changes that affect all levels of operations, which can lead to both immense opportunities as well as the risk of high economic losses. It is precisely at the level of the mid-sized companies where business risk and liability form a unit in the minds of the typical management team: if risk has even the appearance of prevailing, then some corporations simply will not take that first step. «

In which sectors or application areas do you see the greatest use of IoT applications?

» IoT applications produce added value from the connection of uniquely identifiable objects with their associated virtual representation on an internet-type platform. By combining and comparing the virtual images, including current operating data for the associated objects, information can be derived and the design processes accelerated. The basic prerequisite is the connection of the object to the internet, which presupposes the use of IT security measures. The greatest use is thus initially seen in those application areas in which only information which is conditionally worthy of protection is exchanged. Contents such as energy consumption, operating data, or wear information are included here. «

Thomas Holm, PhD engineering, studied mechanical engineering and business administration in Hamburg, London, and Hagen. His PhD thesis at the Helmut-Schmidt University in Hamburg concerned the topic, "The Evaluation of Costs in the Engineering of Modular Process Systems". He has worked in "Market Management Industry & Process" at WAGO Kontakttechnik GmbH. & Co. KG since 2015.

Where do you see the greatest opportunities for WAGO with respect to implementing IoT applications?

» A large opportunity is to be found in the optimization of the production processes. Individual machines are often developed by experts, or can be adapted to a production process during commissioning on site, and adjusted to their environment and optimized. This optimization often does not occur during later operation; the machine drifts away from its operating optimum and functions inefficiently, even leading to increased wear under certain circumstances. By transmitting the specific operating parameter to the expert personnel, the machine could be regularly guided back to optimal operation; the production processes would then operate in a less resource-intensive way, and idle times would be reduced. «

What are the greatest digital challenges for WAGO?

» As a German company and supplier of automation solutions, we have two tasks: on the one hand, we must prepare for changes as a company, e.g. use the added value from digitizing the value creation; on the other, we must develop solutions for implementing this digitalization in automation. We are thus looking at the same challenges as our customers. Together with them, we can develop the solutions. «

WAGO offers solutions for implementing Industry 4.0 concepts – how are these concepts already realized in your own products?

» We regularly test the newest developments and allow the knowledge to flow into our own production. This allows us to maintain our production at a state of the art level. Thus, for example, the degree of networking of our production machines is already quite high, which reduces the use of resources and thus maintains the production facility in Germany as an attractive location. «

Mr. Holm, thank you for the conversation.

FOUR NEW ONES FOR YOUR MEASURING TASKS – THE *JUMPFLEX*® FAMILY OF PRODUCTS IS GROWING

With its four new *JUMPFLEX*® signal conditioners, WAGO is continuing to expand its existing *JUMPFLEX*® portfolio.

The *JUMPFLEX*® 857 Series compact housing concept has set a new standard in signal conditioners that are only 6 mm wide, and offer universal commoning options and numerous technical features. The new, compact *JUMPFLEX*® Signal Conditioners are user-friendly and easy to configure using DIP switches or interface configuration software, and also offer a safe 3-way isolation with 3 kV test voltage acc. to EN 61010-1 and an expanded ambient temperature range from -25°C to +70°C. Moreover, they can be easily marked with WMB and TOPJOB® S marking strips – so you always easily identify them in the control cabinet. Even the new members of the *JUMPFLEX*® family know how to be convincing.

Easily Duplicate Signals

The two configurable current/voltage outputs of the 857-424 *JUMPFLEX*® Signal Splitter enable a variable doubling of the signals at the highest level of security. Disturbance variables are optimally filtered thanks to the switchable operating frequency.

Voltage Recording

The 857-560 Voltage Signal Conditioner enables recording of AC and DC voltages up to 300 V AC/DC and converts the input signal into a standard analog signal at the output. In addition, it has a digital signal output (DO), which reacts to freely configurable measuring range limits. Switching the measuring method between the effective value (RMS) or arithmetical mean value can be carried out via DIP switch or interface configuration software.

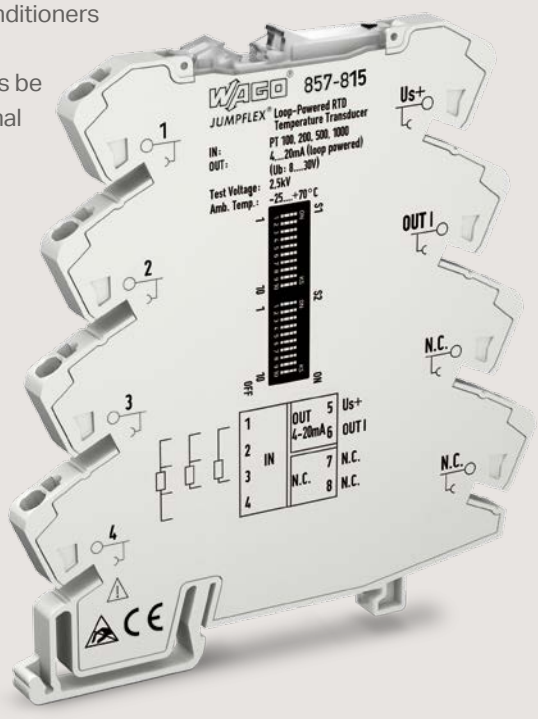
Determining Output

Using the 857-569 Power Signal Conditioner, current and voltage can be measured in parallel, converted into output, and transmitted as an analog standard signal. Measured values, like active power, apparent power, reactive power, and phase angle, are switchable via DIP switch or interface configuration software. The 857-569 Power Signal Conditioner, like the 857-560 Voltage Signal Converter, has a digital signal output (DO).

The Temperature at a Glance

The Loop-Powered RTD Temperature Signal Conditioner records Pt sensors and resistors up to 4.5 kOhm and converts the temperature signal into an analog standard signal on the output side. The 857-815 is supplied via an output loop and thus does not require an additional supply voltage.

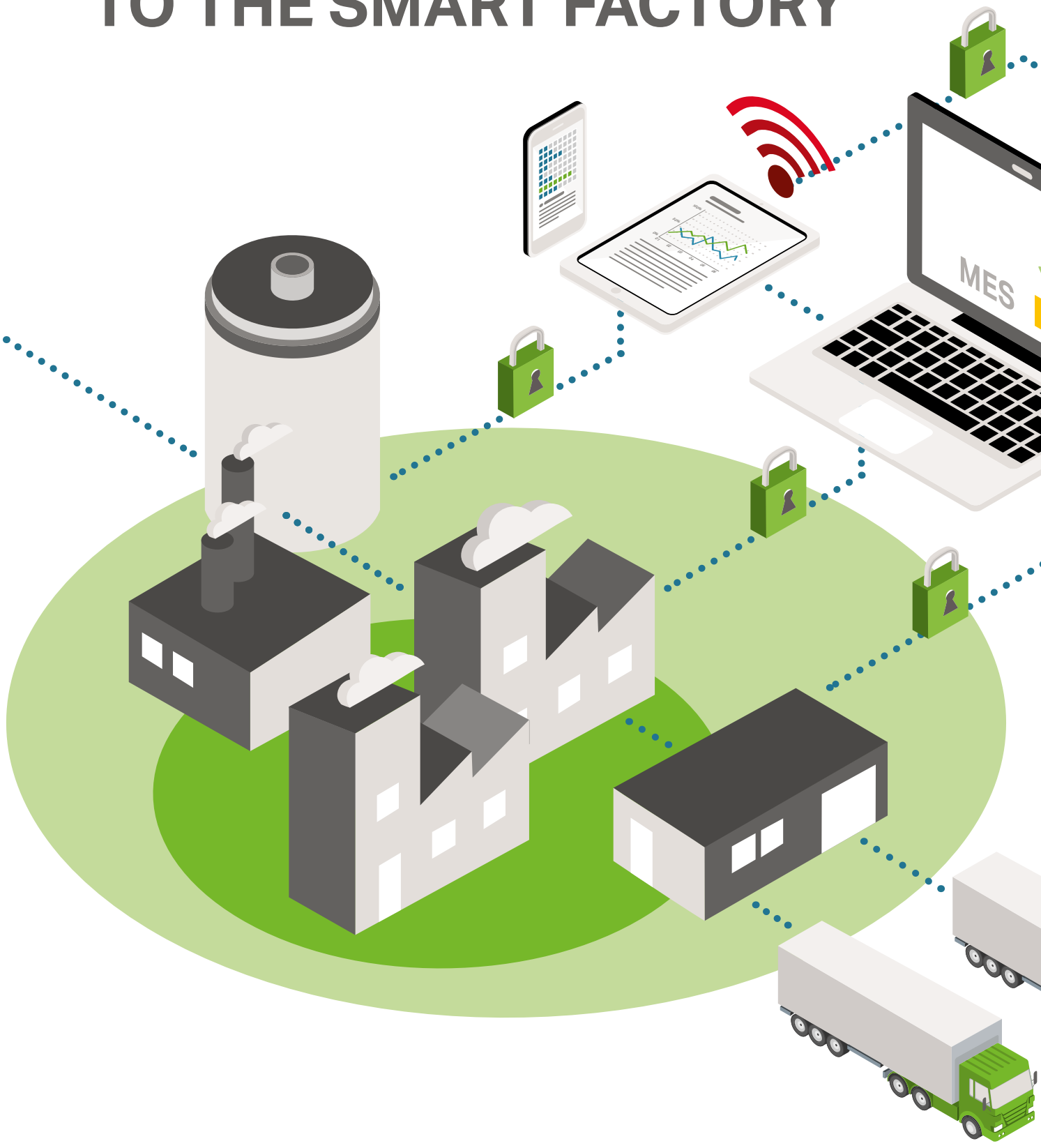
The new *JUMPFLEX*® Signal Conditioners fill out the existing *JUMPFLEX*® product portfolio. WAGO will thus be able to offer its customers optimal and tailored solutions from one source in the future as well.

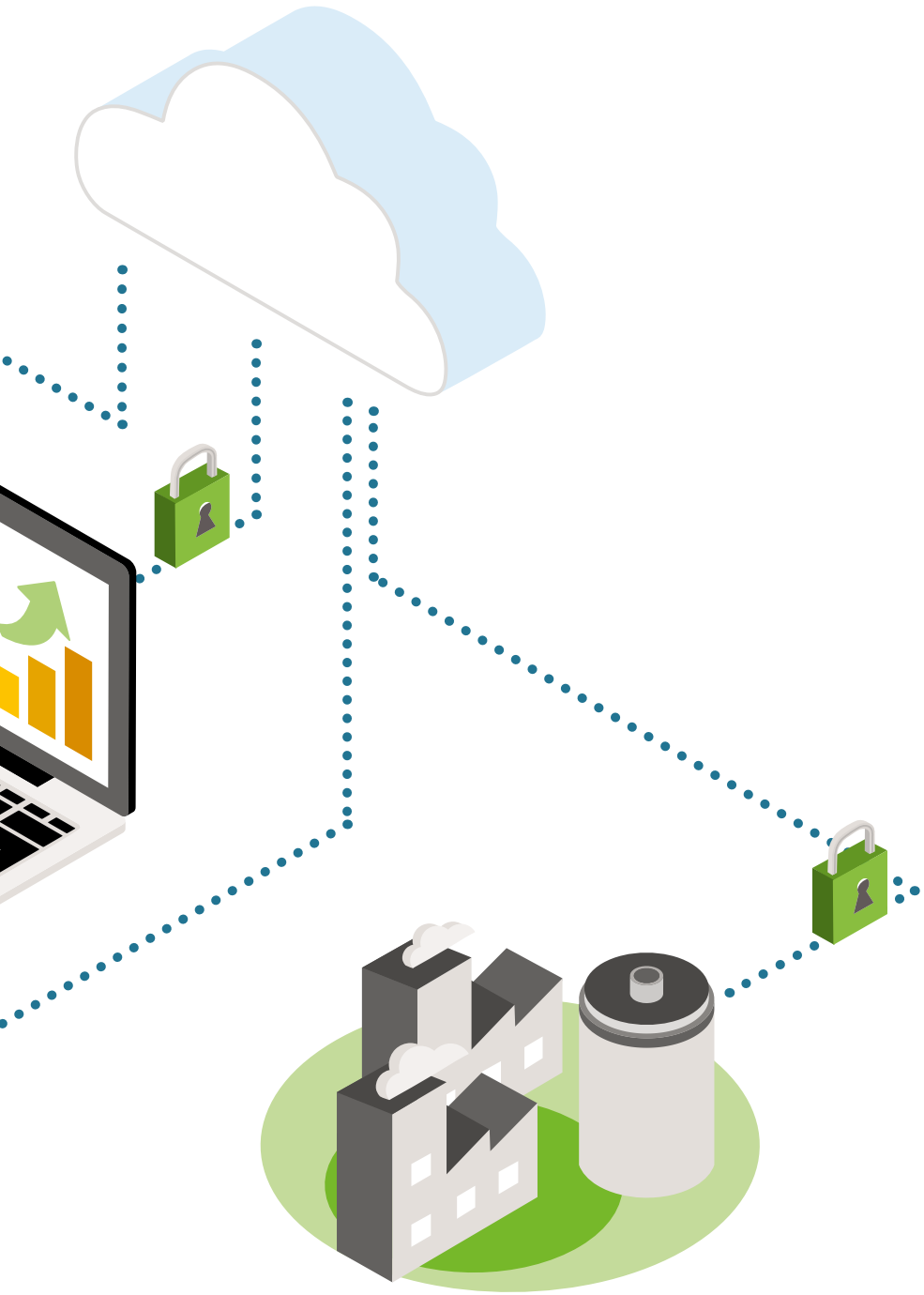


Measuring solutions from a single source: The new *JUMPFLEX*® Signal Conditioner optimally supplements the existing portfolio.

Measure First, Then Manage

ON THE ROAD TO THE SMART FACTORY





The networked, intelligent, self-controlling, self-optimizing, and resource-efficient production is the central scenario of Industry 4.0 – the Smart Factory. Despite the alleged advantages that Industry 4.0 production appears to offer, questions remain for many companies, such as: why is it even necessary? what level of their own production must attain 4.0? and what steps should be the first on their path to the Smart Factory?

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It is undeniable that an intelligent, resource-efficient, and cost-efficient production is gaining significance against a background of increasing international competition. The advantages of Industry 4.0 will therefore produce results primarily in the future, and will determine the future of the production facility in Germany. Because Germany is still a country with high labor costs. Labor costs are now, as previously, over-proportionally high in comparison with abroad. Because the Federal Republic is among the leading global countries with respect to the proportion of GDP in industrial production, there are significant efforts to reinforce production operations using a maximum level of automation. And due to the increasing level of automation, modern infrastructure, IT expertise, and proximity to regional markets, companies are beginning to relocate their labor-intensive production back to Germany. In this context, there are those in industry who are already talking about a re-industrialization, similar to that occurring in the USA. The fact is that industrial production is one of the pillars supporting the German economy, and should remain so into the future.

WAGO's automation solutions reliably store production data error-free from the field level to a higher-level system or to the cloud.

Individual Ideas for Tomorrow's Production

However, in order for Germany to remain an attractive location for manufacturing companies, these corporations must also be in a position to manufacture profitably, even in the context of individualization and globalization. The ability to manufacture products according to lot size 1 without substantially increasing production costs will be an indicator for the Smart Factory for companies. The future success of producing companies will be determined by their production changeability and the ability to network to a high degree along the entire value chain – right up to the end product. How this will be specifically implemented in production essentially depends on the existing underlying conditions. The Smart Factory cannot be imposed as a solution; instead, the smart version of an extant production line must be as individual at the processes of the producing company itself. Before considering how Industry 4.0 can be technologically introduced into existing production, there must be consideration as to which ideas, methods, or approaches can lead to an improvement in the existing individual production processes. These improvements may lie in more efficient use of

resources during production, preventing duplication of applications along the value-added chain, or significantly shortening system engineering times. For example, there are potential advantages for machine and system designers in observing a system after the sale and obtaining as much data from the life cycle as possible, which would allow them to draw conclusions to apply to refinements in their own work, or would enable them to provide recommendations to their clients about operating the machines.

Measure First, Then Manage

No matter which method is applied for transitioning from the merely extant to the Smart Factory, networking of existing processes and operations remains a prerequisite. This networking includes the vertical, namely from the control system to the field level, as well as the horizontal, which extends beyond the various steps in the value-added chain. The only opposition to this type of complete networking today is that the data cannot be consistently generated and used. Diverse media and system discontinuities, which occur in both the vertical, but primarily in the horizontal integration, introduce difficulties in correlating data logically and sensibly across processes. As a rule, each Industry 4.0 approach initially proposes recording data, digitizing them, and linking them to one another in a profitable way. This step is precisely the central thought driving Industry 4.0:

Plant operators retain an overview of their production facilities thanks to the cloud capability. These complex processes cannot only be captured with little effort, they can also visualized, for example via a smartphone or tablet.

collecting, networking, and evaluating data from the production process in order to exploit them profitably such that a sustainable added-value is generated for the corporation.

Data Transparency for the Smart Factory

The essential criteria, which characterize a Smart Factory, are those that enable the measuring, networking, and evaluation of data:

- Sensors at all levels, including down to the product level and the product itself
- Networking all components and internet connection
- Maximum IT security

The first step along this path is transparency across all production- and system data. Only when the data have been brought into context with one another, suitably processed, and consolidated into information, can measures be introduced to improve the production process. For this to succeed, sensors must record product- and production-relevant data at the field level. These sensors have to be considered in the system architecture or incorporated into the product itself, for example, in the form of RFID chips. With regard to production-relevant data, which is recorded via sensors on the machines and systems, the challenge consists less in the mere collection of data, but instead in bringing the data securely and error-free from the field level into a higher level, for

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WAGO's automation solutions make production efficient and profitable despite Germany's high labor costs.

example, a MES (manufacturing execution system) or the cloud. So how does this work?

Automation solutions can provide a decisive contribution, like the modular WAGO-I/O-SYSTEM 750, which, with more than 500 different modules, can offer a suitable solution for practically any application area. Thus, signals can always be reliably collected from the field level and further processed. When supplemented by the PFC Controller family from WAGO, different interfaces and fieldbuses can be used, independent of manufacturer, like CANopen, PROFIBUS DP, DeviceNet, and Modbus-TCP. The WAGO controllers can also be incorporated into already existing automation systems as scalable nodes and gateways, which can be retrofitted without having to interfere with the actual automation process; the data can then recorded in parallel and transmitted to a higher level, an MES or the cloud. In this context, the advantages connected with a cloud link initially appear quite promising: cloud solutions are flexible, scalable, are highly available, and provide the opportunity for centralized access. They can also be used to comfortably manage large quantities of data. That the cloud has gained less acceptance in Germany than might have been expected appears to be based on opinions regarding IT security and the protection of proprietary knowledge; these are critical considerations about the cloud and whether companies should provide or withhold important business data. And rightly so! Those who want to use the advantages of the cloud must also consider the measures that must be undertaken in terms of IT security.
Extant security mechanisms do not provide sufficient protection for the transportation of digital data from the field level to the cloud. And this is not simply because a cloud connection bypasses most security mechanisms that have already been established – in the sense of a defense in depth solution: access controls, authorization concepts, and firewalls among them (see also the graphic on pages 30 and 31 for more information).

Flexible and Safe

What is required to transport data from the field level to the cloud are so-called "IT security by design" solutions. Examples include hardware and software, which are programmed from the outset to transmit data in an encrypted manner and to prevent external access. With the PFC Controllers, WAGO provides a controller which is already several steps beyond this point, because the PFC family of controllers already possess comprehensive onboard security mechanisms for the secure transmission of data. Thus, data can already be encrypted and secured, for example, by using SSL/TLS 1.2 (Secure Sockets Layer/Transport Layer Security) encryption. Secure connections are established via a "virtual private network" or VPN. All controllers in the PFC family have these functions. Secure connections can be established directly from the controller via IPsec or OpenVPN. In addition, the controllers also have a configurable firewall. An upstream router or PC is thus no longer required, which saves costs and administrative expense. Thus, WAGO already fulfills all relevant guidelines in IT security and in a position to satisfy the requirements from the BDEW white paper for applications in the "critical infrastructure" sectors.

Creating Added Value

In order that one does not drown in the resulting data flow, applications for data analysis place a decisive role. If they are incorporated correctly and make use of the individually relevant key performance indicators (KPIs), then the existing process can be fundamentally improved, depending on where one places the focus, i.e., time, resources, or energy. More is thus accomplished on the road to a Smart Factory than a single step.

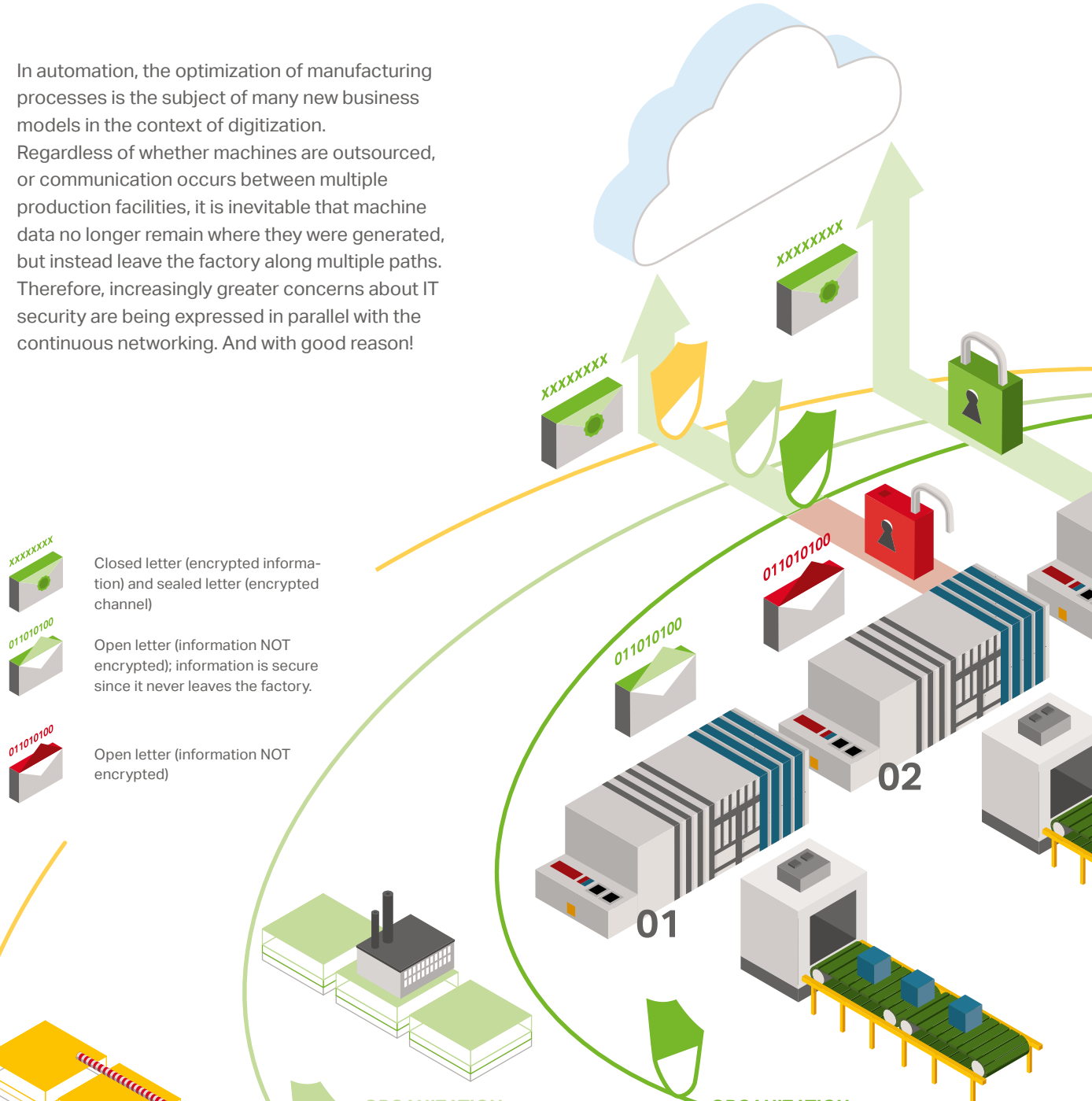
TEXT ULRICH HEMPEN, THOMAS HOLM, NILS WIGGER | WAGO

FOTO Fotolia.com, iStock.com, WAGO

The next decisive step

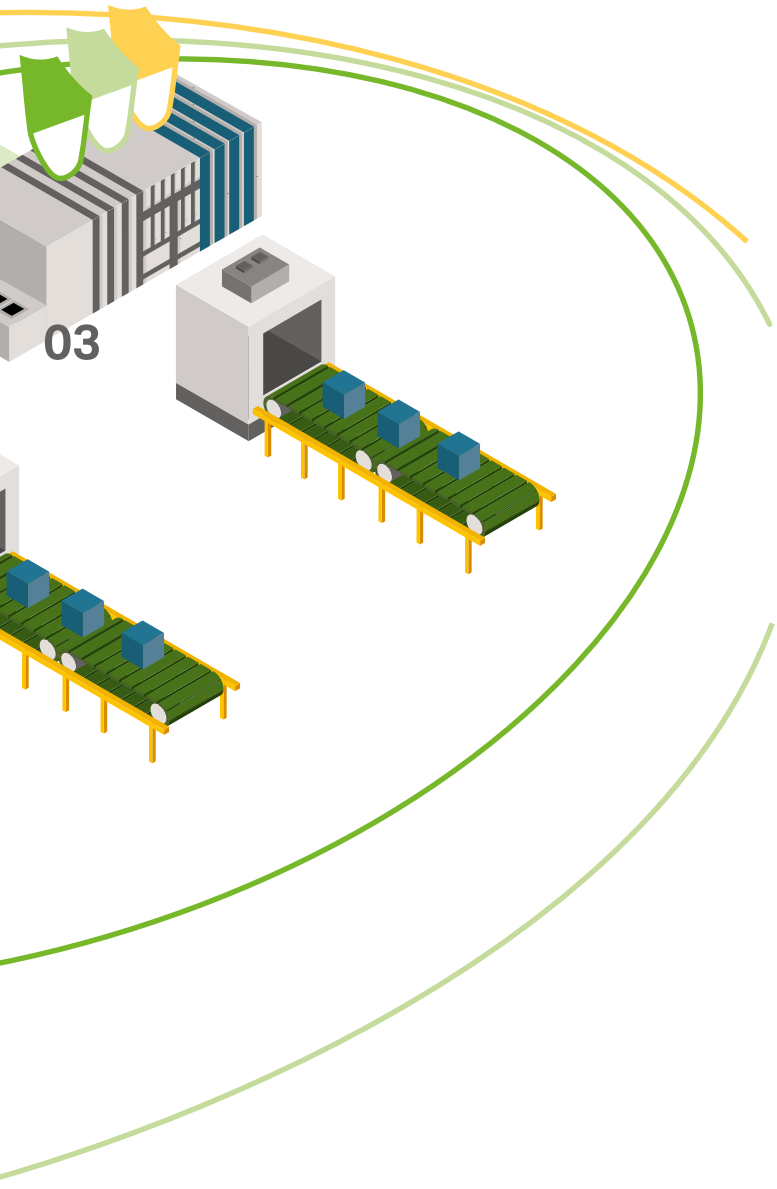
IT SECURITY MADE BY WAGO

In automation, the optimization of manufacturing processes is the subject of many new business models in the context of digitization. Regardless of whether machines are outsourced, or communication occurs between multiple production facilities, it is inevitable that machine data no longer remain where they were generated, but instead leave the factory along multiple paths. Therefore, increasingly greater concerns about IT security are being expressed in parallel with the continuous networking. And with good reason!



Existing security mechanisms for the transportation of digital data from the field level to the cloud no longer suffice. Access controls, authorization concepts, and firewalls, which need be established only once to form a defense in depth, can be bypassed by a cloud connection. To transport data from the field level to the cloud, so-called “IT security by design” solutions are required.

These include hardware and software components, which are programmed from the outset to transmit data in an encrypted fashion and thus prevent external access. The PFC Controllers from WAGO are already several steps beyond this point: the controllers in the PFC family already possess comprehensive onboard security mechanisms for the transportation of data.



01 PREVIOUSLY:
DATA REMAINED IN THE MANUFACTURING HALL
For a long time, machine data were only evaluated and used in the manufacturing facility in which they were generated. Thus, the risk of undesired data access was relatively low. By establishing classic defense in depth measures, the machine data were well protected.

02 DIGITALIZATION:
DEFENSE IN DEPTH REPRESENTS RISKS
The continuing digitalization requires constant availability of data at various locations. Therefore, machine data must be encrypted. The path of the data from the controller to an external encryption component, like a router or firewall, can, however, be exposed to the risk of undesired data access.

03 THE SOLUTION:
DATA ENCRYPTION IN THE CONTROLLER
The WAGO PFC100 and PFC200 Controllers encrypt information directly in the controller and subsequently transmit the data to the cloud via IPsec or OpenVPN. Machine data are thus optimally secured from undesired data access (see also pages 36 and 37).

"SECURITY IS BECOMING A KEY DISCIPLINE IN AUTOMATION TECHNOLOGY"

The idea that a smart, networked, intelligent, autonomous, and resource-optimized production will pay companies back has become "common sense". Prof. Dr. Jörg Wollert, who has served on the teaching faculty at the University of Bochum, the Technical University Bielefeld, and the Technical University Aachen, explains in an interview with **WAGODIRECT** what steps should be the first on the path to the Smart Factory and where corporations cannot afford to drop the ball.

The Industry 4.0 vision of the Smart Factory includes the digitalization of production and the use of diverse, production-relevant data. What challenges does this pose for IT security?

» The question is very complex, to the point that it can scarcely be answered in a comprehensive way. Let's start with Industry 4.0. This does not mean that one can buy products that are "Industry 4.0 ready"; instead, it describes the implementation of a comprehensive strategy that extends from design to operation. This is more complex and significantly more comprehensive than mere automation.

Smart Factory assumes digital communication across an entire corporation. The coordination of business processes and the free exchange of data without incurring side effects are all part of this. However, business processes are usually not in any type of digitizable form, so it is impossible for an actual exchange between corporate entities. Confidentiality in the development of digital business processes includes proprietary knowledge, which must be secured in all circumstances.

Industry 4.0 demands a design which encompasses the entire corporation. In many sectors, this foundation has not yet been prepared to the extent that plug-and-produce would even be possible. Similar to the exchange of data in business processes, engineering also has very high demands for confidentiality. Security has the highest priority here as well.

The use of diverse, production-relevant data assumes – once you think it through – a Big Data approach. However, most companies have yet to arrive at this point. Data are often kept at the local level for good reasons. Ultimately, production data have a lot to say about the performance of equipment, infrastructures, units, and even people. Many questions have yet to be answered with regard to this, particularly those with societal implications.

In summary, one can state with confidence that the high degree of networking in all sectors of production – from design and engineering through production up to life cycle maintenance – will be extremely challenging. Security will play a decisive role at all levels. Security is becoming a key discipline of automation technology for all Industry 4.0 approaches.

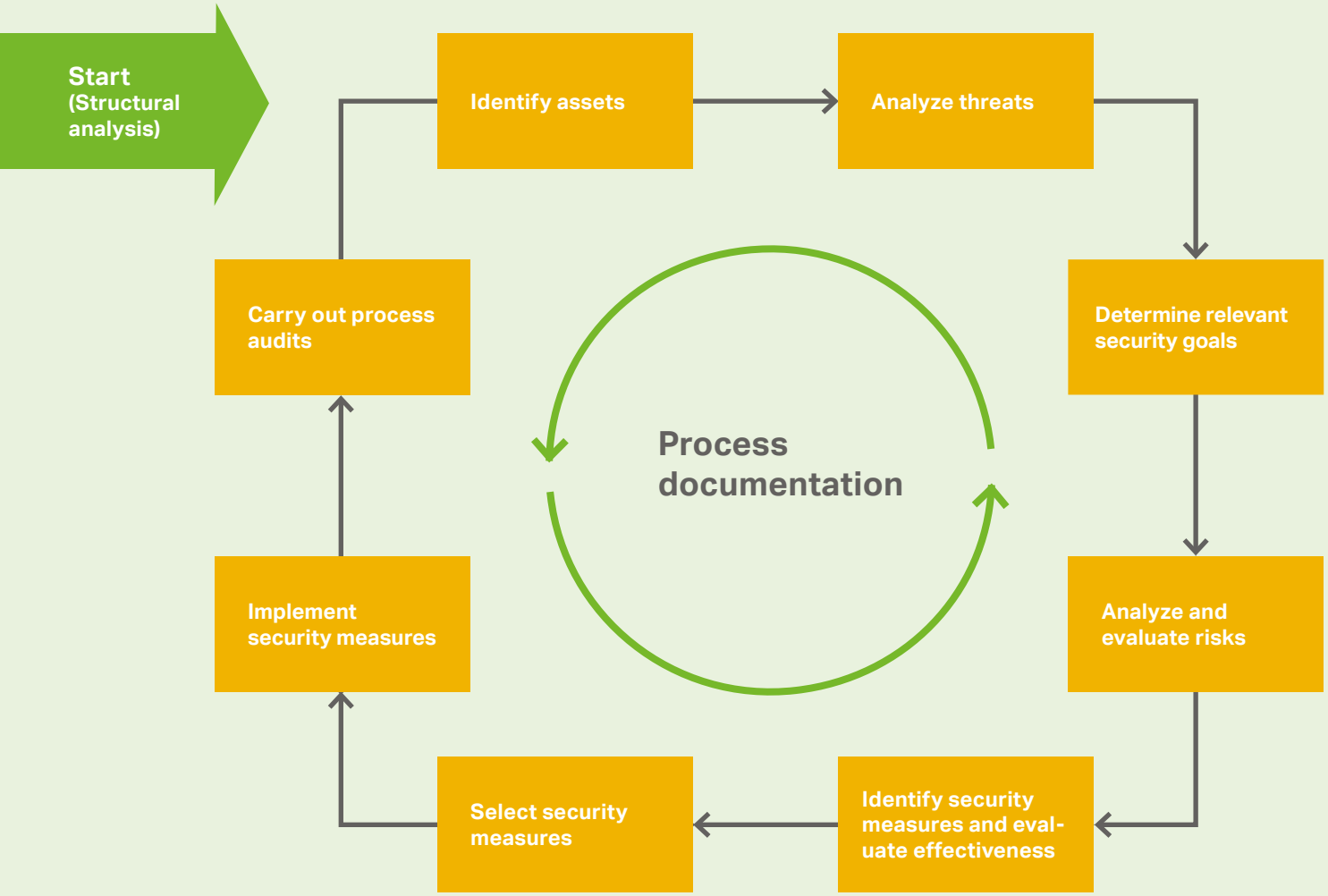
Keeping all of this in mind: the question regarding "challenges" is easy to answer.

- We will have to learn to control new levels of complexity.
- A security level appropriate to the respective security requirements must be implemented.
- Employees must learn to embody security – they must internalize and intrinsically implement the security goals. «

In this context, how do you evaluate existing paradigms like defense in depth?

» Defense in depth is a highly promoted concept. Since IEC 62 443 and ISA 99, it is clear to everyone that all participants have to ensure "security". In the standard, the roles of manufacturers, integrators, and operators are listed – they all have to do their homework. In addition, the context of defense in depth addresses domain-based approaches, meaning that data are assigned to a security domain. The standard distinguishes here between low, medium, and high impact information systems. If a great deal of damage can be wrought, then a higher level of security is necessary, which is only logical. What this approach clearly reveals is that no sensible security goals can be defined without risk assessment and risk analysis. It clearly reveals that security cannot be "manufactured" simply by purchasing electronic devices. Security can only be achieved by design; and defense in depth is only a prerequisite. Ultimately, the entire "system" has to be evaluated, including all external boundaries and interfaces to third-party systems. This can only be achieved by strategic preparation. «

Prof. Dr. Jörg Wollert was born in 1964 and studied electrical engineering at the RWTH Aachen university with a focus on retrofitting technology. He received his doctorate from the faculty in mechanical engineering. Research areas include distributed realtime systems and the design of intelligent mechatronic components. After working in industry as a project manager in image processing and logistics systems, he returned to academia as a professor at the University of Bochum in 1999. He taught at the Technical University Bielefeld, and joined the faculty at the Technical University Aachen in March 2015. He lectures on "Mechatronics and embedded systems" and develops departmental activities related to Industry 4.0. His expertise is documented in more than 200 publications, numerous textbooks, and multiple seminars in his subject area.



Current discussions question existing security concepts and demand "IT security by design." What do you understand by this?

» What are existing the security concepts? Securing a network with a firewall and then done? Or simply an air gap, in which networking is not carried out by design?

Every security concept arises only in the sense of security by design. Security cannot be forced; however, security strategies are required which can be adapted to the respective security goals – from the administrative level down to the components. IEC 62 443 is a completely complex text that includes many relevant aspects: thus, 62443-2 describes the policies and procedures for an organization; 62443-3 describes the system and demands placed on it; and 62443-4 addresses the components. «

In your opinion, are there advantages with respect to IT security for controllers based on a Linux® system?

» If we remain at the level of understanding described in IEC 62 443, then we are only talking about "components", the industrial automation control system (IACS). A secure component only corresponds to one part of a security concepts. In this case, Linux®, when used correctly, has the advantage. This operating system is used by a broad community in many embedded systems with security functions. The majority of switch and router firmware is based on Linux®. Consequently, the questions with regard to protocols, patch levels, operating system quality, internal structure, etc., are known, so that strategic approaches can be implemented. In the long term, this is better than the security by obscurity of proprietary systems. The Linux® operating system innately offers all possibilities

for implementing security strategies, and there is a large community that supports Linux® as a secure operating system. «

Within the context of one of your recent presentations, you described the PFC family of controllers from WAGO as a good example of IT security. Why?

» When implementing system solutions, corporations can do a lot of things incorrectly with respect to security. These almost always include "exciting" system solutions from various manufacturers. WAGO provided the PFC Controllers with a solid Linux® foundation such that each controller can be virtually operated as a secure gateway. Essential security protocols are supported, and anything lacking can be provided by the Linux® community.

The PFC from WAGO is not just a PLC that can access the internet, but instead a fully-fledged Linux® computer that can also run a CODESYS PLC runtime. This way of thinking grants the correct meaning to IT. Since realtime does not have to be relinquished, the IT components don't represent a disadvantage – now they offer the potential of interacting with the IT. «

In your opinion, what are the first steps that a corporation should take along the path to the Smart Factory?

» If one considers the typical challenges of a mid-sized company, then digitalization of the business processes is the most important first step. Many documents are certainly available electronically; however, a comprehensive process description, which enables problem-free automation, is quite challenging. Even when this first step has been completed, specific use cases still have to be considered.

The definition of digitizable scenarios is later reflected in the applications and in the communication relationships with the customers, the corporation's subsidiaries, operational employees, and maintenance personnel. These are the sources of future demands on the entire system. Only then can one talk about secure architecture and secured zones. And this is the precise point when things get technical. «

What aspects must be considered when retrofitting automation systems – explicitly with regard to the challenges that result from Industry 4.0?

» Retrofitting has its own rules. As a rule, you can't reinvent infrastructure; you have to deal with the existing configuration. It is easier if ETHERNET-based networks are available, or if ETHERNET-based networks can be used. In this case, the various security and communication challenges must be addressed and secured in a suitably hierarchical infrastructure. Secure gateways between domains should receive emphasis, likewise the controller PLC, as that is a gateway from the field level into IT. «

Dr. Wollert, thank you for the conversation.

IT Security up to the Controller

AUTOMATION MEETS IT – THE PFC FAMILY FROM WAGO

IoT applications demand reliable automation technology – in addition to or explicitly with a focus on IT security. Ultimately, production data are a valuable asset that must be particularly well protected. The PFC100 and PFC200 Controllers from WAGO not only encode data using SSL/TLS 1.2 in the controller, but also transmit the data securely to higher level systems.

On the way to production in the future, there are still a few challenges to be mastered. One thing is clear: a Smart Factory cannot be purchased off the rack. Applications and solutions in the intelligent facility are as individual as the specific production processes themselves. However, in order to take the first steps in the direction of the Smart Factory, transparency across all processes within the manufacturing plant is an initial necessity. Production data must be recorded at the field level and securely forwarded to a higher level system. There, the collected information are linked with one another such that real added value is created for the company. This added value can consist in, for example, revealing interrelationships, optimizing control in the production processes, or simplifying the design of systems. While corresponding automation solutions were previously developed by pure automation specialists, a close collaboration with the IT department is unavoidable in the age of networking: this is the only way that the collected data can be securely recorded, transmitted, and adequately evaluated. The Smart Factory can only become reality through this connection.

Solid and Versatile

The PFC100 and PFC200 Controllers from WAGO take these developments into account. They are characterized by a cross-platform realtime Linux® system, which is available as an open-source operating system that can be scaled and updated, and supports tools such as Rsync. Consequently, they can be used as secure gateways. The factory-installed Linux® foundation not only supports essential security protocols, it also ensures that these will be constantly refined thanks to the large Linux® community. The WAGO controllers are thus not merely a simple PLC that is capable of transmitting data to the cloud, and instead is a fully-fledged Linux® computer, which also happens to support CODESYS PLC Runtime. An additional advantage: various interfaces and fieldbuses such as CANopen, PROFIBUS DP, DeviceNet and Modbus-TCP can also be operated independent of the manufacturer.

Security on All Levels

There are different requirements for the level of a safety solution, depending on the application and the risk analysis. All members of the WAGO PFC200 family are designed to implement the current highest security requirements according to ISO 27000. They provide onboard VPN functionality based on the so-called strongSwan package and the OpenVPN package, a secure communications solution for Linux® operating systems. In addition, the data in the PFC200

Controller can already be encoded using SSL/TLS 1.2 (Secure Sockets Layer/Transport Layer Security) encryption. A VPN tunnel is then established directly via IPsec or OpenVPN and transfers the data to the cloud, even wirelessly if desired. While IPsec encrypts at the operating system level or layer 3, OpenVPN ensures data integrity on the application layer (layer 5). This results in communication connections between the controllers and network access points that cannot be bugged or manipulated by third parties. An upstream VPN router is no longer required. During communicating with a PFC200, an encrypted LAN/WAN connection can be established, and the contents of those interchanges can only be understood by the two endpoints. Connections are established only after successful authentication. An encryption method with a pre-shared key is used, in which the keys must be known to both parties prior to communication. This method has the advantage that it is easy to implement. Alternatively, a x.509 certificate is provided, which is a method in which a public key infrastructure generates digital certificates. Due to the strong security concept of the PFC200, WAGO already currently fulfills all relevant guidelines in the area of IT security and even a large number of the requirements from the BDEW white paper for applications in the field of energy and water supply, which are part of the “critical infrastructure“ (CIP).

Convincingly Flexible

The PFC200 can also be used as a scalable node, which can be retrofitted into already existing automation systems without interacting with the actual automation process – data is collected in parallel and can be transmitted to the cloud, for example via MQTT or OPC UA. This is another case in which the user profits from the security features of the WAGO controllers. An internal production use of the data is also possible via linkage to the manufacturing execution system (MES). Users can thus securely and preventively monitor their systems. System operators have the opportunity to maintain an overview of their production facilities due to the cloud capability. Complex processes can be recorded, and also mapped and visualized via smartphones or tablets at low costs and with relatively simple means. Relevant areas can be filtered according to depth of detail by using a a graduated hierarchy. In this way, potential error functions can be localized more easily and earlier.

TEXT MARC-ANDREE PAUL, JENS KRAKE | WAGO

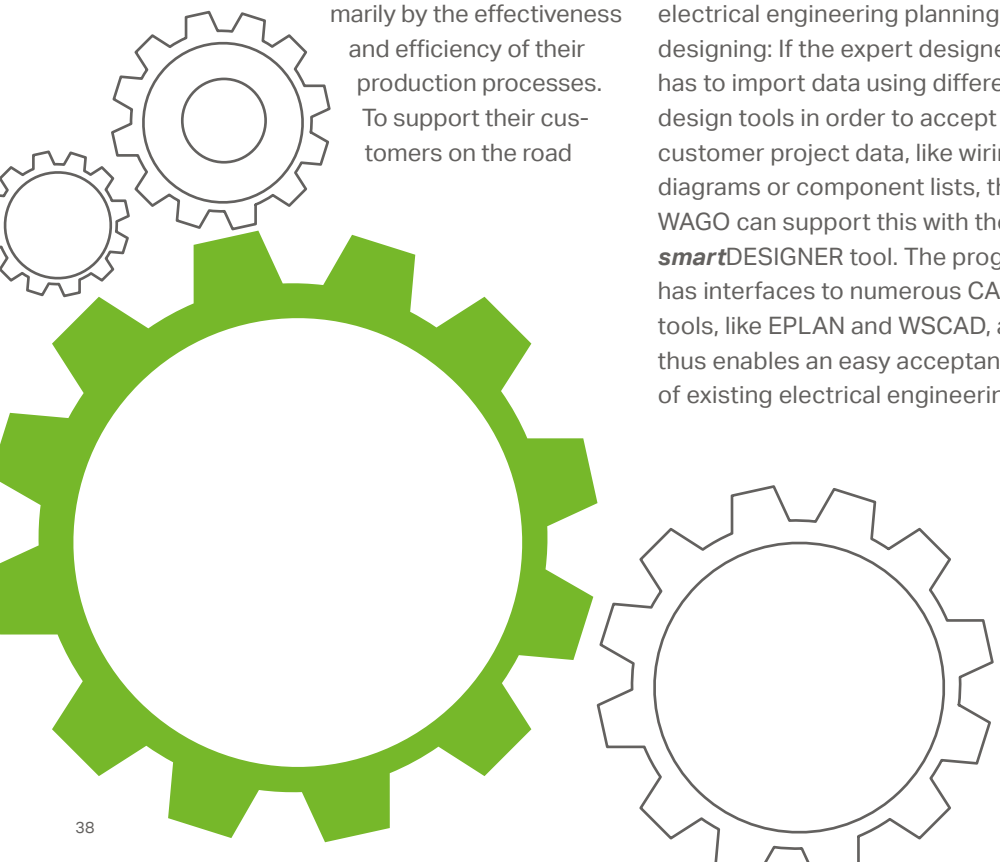
PHOTO WAGO

Transparency along the Value Added Chain

FROM THE DESIGN TO THE FINISHED PRODUCT

In the industries of the future, ordering and production processes will be increasingly digitalized and automated. The goal: consistency and data transparency along the entire value-added chain in order to reduce costs and times and prevent unnecessary added expense. To support this horizontal integration, WAGO offers a solution, ***smart***DATA, an engineering service that assists users from planning and designing through engineering up to testing and commissioning.

During this period of implementing Industry 4.0, the complexity and individualization of products is increasing, greater specialized expertise is required, and pressures to hold down costs are also greater, such that companies find themselves caught between the good and the inexpensive. Corporate competitiveness is ultimately determined by the expertise of their employees and the features of their products or services, but primarily by the effectiveness and efficiency of their production processes. To support their customers on the road to greater efficiency, WAGO offers ***smart***DATA, an engineering service with a multitude of data and services focused on individual products and solutions. This enables consistent data handling and prevents system interruptions between different facilities, which can lead to iterations and thus to a significant added expense.

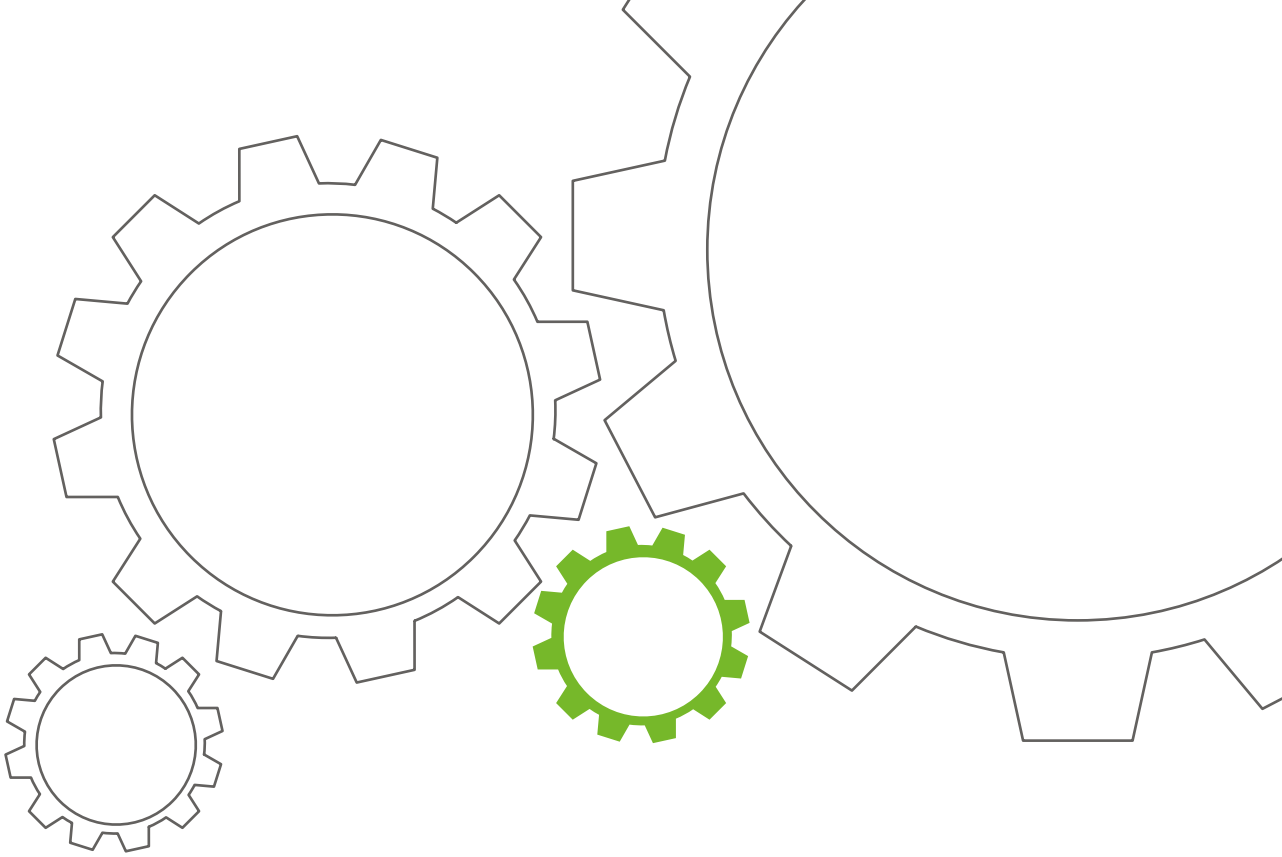


A Unified Field Solution

This is already applicable during electrical engineering planning and designing: If the expert designer has to import data using different design tools in order to accept customer project data, like wiring diagrams or component lists, then WAGO can support this with the ***smart***DESIGNER tool. The program has interfaces to numerous CAE tools, like EPLAN and WSCAD, and thus enables an easy acceptance of existing electrical engineering design statuses. As a web application, the software is also conveniently accessible via the internet and does not require integration by an IT department. This saves both time and money because outsourcing to an external service provider is not required, there are no invoices for new installations or software updates, nor do problems arise between different software versions. Design statuses can be administered or recycled by setting up an independent account.

If electromechanical components or automation systems from WAGO are used, then ***smart***DESIGNER supports project designers by providing a direct link to WAGO's online catalog. The most current product information is always available as data sheets, including product pictures, and downloads of CAE and CAD data.

If, e.g., a carrier rail is configured, ***smart***DESIGNER automatically checks it. The application knows, for example, when using rail-mounted terminal blocks, that an end plate must be placed to prevent contact



between live parts. If controllers are planned, the start-up current is calculated, among other things, in order to determine a need-based power supply. Once the design is completed, the desired products, including pre-assembled carrier rails, can be ordered via the online shop. They are manufactured individually for the client and then shipped.

After a check of the logic in ***smart***DESIGNER, the data can be compiled for further use or graphically displayed in 3D for further review, and then documented. Parts lists, pictures of the products used, or marking data for components that will be incorporated later in the control cabinet, can be generated and printed, for example, for the rail-mounted terminal blocks.

Horizontal Integration – from ***smart***DESIGNER to ***e!****COCKPIT*

If intelligent components are planned for the carrier rail, it is possible to easily transfer data from ***smart***DESIGNER to the ***e!****COCKPIT* software tool. WAGO offers ***e!****COCKPIT*, a software tool for programming complete components that was explicitly designed to be user-friendly and intuitive to operate. ***e!****COCKPIT* supports all manufacturing steps – from hardware configuration and programming through simulation and visualization up to commissioning. In order to flatten ***e!****COCKPIT*'s learning curve, the user interface looks and feels like the one from the current Office programs. And to maintain transparency in a project, even as the complexity increases, the user interface prominently features a context-sensitive menu. This means that only those menu points and functions appear that could be currently used in the design or operation. Components can be placed in the main area of the user interface and virtually connected to each other using drop & drag. And because this convenience prevents connection errors from ever occurring, it also prevents costly troubleshooting after installation. Since several controllers can be simultaneously configured and programmed in ***e!****COCKPIT*, it is possible to simulate and run through different test scenarios for the planned system.

While ***smart***DESIGNER functions as a powerful online design tool to guarantee interfaces for electrical designs, accelerates the entire design and ordering processes, and additionally offers optimal possibilities for documentation, the interface to the ***e!****COCKPIT* software tool guarantees consistent transmission of design data for further configuration and programming of the automation components. This supports that decisive, competitive step of quickly and safely implementing new machine functions in modern equipment and systems.

TEXT THOMAS HOLM | WAGO

PHOTO WAGO

Industry 4.0: WAGO Lecture Series in Augsburg

THE PATH: THE CORPORATION, VERSION 4.0

The usefulness, that Industry 4.0 is expected to provide, remains uncontested. However, perceptions about specific contents and goals of the fourth industrial revolution appear rather diverse. Has its presence in the mainstream gotten confused, even though the topic has dominated the specialist media for years? Is it difficult to understand and thus hard to comprehend? At an informational event about Industry 4.0, WAGO has provided another layer of clarity to this dominant topic.

Even after the presentations, the participants remained in the home stadium of FC Augsburg to discuss the challenges and opportunities of Industry 4.0.

More than five years have passed since the expression 'fourth industrial revolution' was first uttered at the Hannover Messe. "Are you also involved with Industry 4.0?" was a typical question in 2011 and even 2012, when it usually received either a shrug or that smile that can mean so many things. And 2016? Can Industry 4.0 be dismissed as a fast-moving fad, similar to a short automation hype, or can long-term trends be recognized that sustainably change the tomorrow's production processes?

The answer is clear: Industry 4.0 represents a clear trend, and Jürgen Pfeiffer, *AUTOMATION* Account Manager at WAGO can prove it using interest curves. Because, while the awareness of a fad ebbs away as quickly as it grew, the interest in Industry 4.0 and the Internet of Things has constantly increased. In contrast, perception of what it is appears almost heterogeneous, because the goal of a comprehensive integration of production means has horizontal and vertical effects. While factory designers focus on the vertical integration and networking of manufacturing, the possibility of horizontal networking along the value-added or delivery chains are of greater interest to controllers.

Regardless of the differences between perspectives and goals, the paths toward implementation appear surprisingly uniform, and that has ultimately emerged in general modeling processes, like RAMI in Germany or IIC in the USA. It was clear at the presentations, with participants from widely different sectors and applications, that Industry 4.0 is not only being considered in terms of general feasibility. Instead, the networking is generating completely new questions, including business and ethical discussions, as well as challenges that affect IT security.

While Thomas Gaus, Group Leader for Cloud Systems at M&M Software GmbH, located in St. Georgen, referred in his presentation to the fact that the Internet of Things, and the Industry 4.0 which is based on IoT, would not be possible without cloud computing, the podium speakers quickly raised questions about data security and how proprietary expertise is organized in the cloud. What do I transmit? how? and at what level of detail? Jürgen Pfeiffer, *AUTOMATION* Account Manager at WAGO, took a critical look at this question in his presentation. It was clear for Pfeiffer that, for all of the questions about what could be used in which cloud-based forms, it was the usage itself that had to be the focus. "It's not just about the data, but instead about the advantages that arise for everyone, if we can introduce them profitably. What do I do with the data? how do I use them? how do I protect them?"

»It's not just about the data, but instead about the advantages that arise for everyone, if we can introduce them profitably.«

What is exciting in this context is that new players have entered the classical field of automation with Industry 4.0. Companies like Microsoft or Amazon originated from very different sectors; yet they are now offering cloud solutions in a grand style.

TEXT THORSTEN SIENK

PHOTO THORSTEN SIENK

Rail-Mounted Terminal Blocks for Switchgear Production

SMALLER, FASTER, AND PARTICULARLY VERSATILE

JOKIEL GmbH designs and manufactures switchgears for various sectors. TOPJOB®S Rail-Mounted Terminal Blocks from WAGO are an important component to satisfy demands for low throughput times and high quality, qualities for which the family-owned corporation in the Upper Palatinate is known.

„The systems our customers build are used all over the world," according to Thorsten Jokiel, who serves as CEO of JOKIEL GmbH together with his brother Markus. "We collaborate with leading manufacturers, who are acknowledged as globally important and produce correspondingly certified products." When it comes to connection technology, JOKIEL relies on WAGO; they have been equipping their control cabinets with TOPJOB®S rail-mounted terminal blocks since 2006.

From Buildings to Car Manufacturers

JOKIEL, headquartered in Amberg, around 50 kilometers east of Nuremberg, manufactures switchgears for various applications. Founded in 1982, Bernhard Jokiel initially concentrated on building technology; however, the switch to the construction of switchgears for specialized systems occurred soon after. Today, 50 employees manufacture control cabinets for companies from,


XB0
L1
L2
L3
PE
L11
L12
XB1
1
2
3
4
5
6
7
XB3
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3
4
5
6
7
8
9
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XB31
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4
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6
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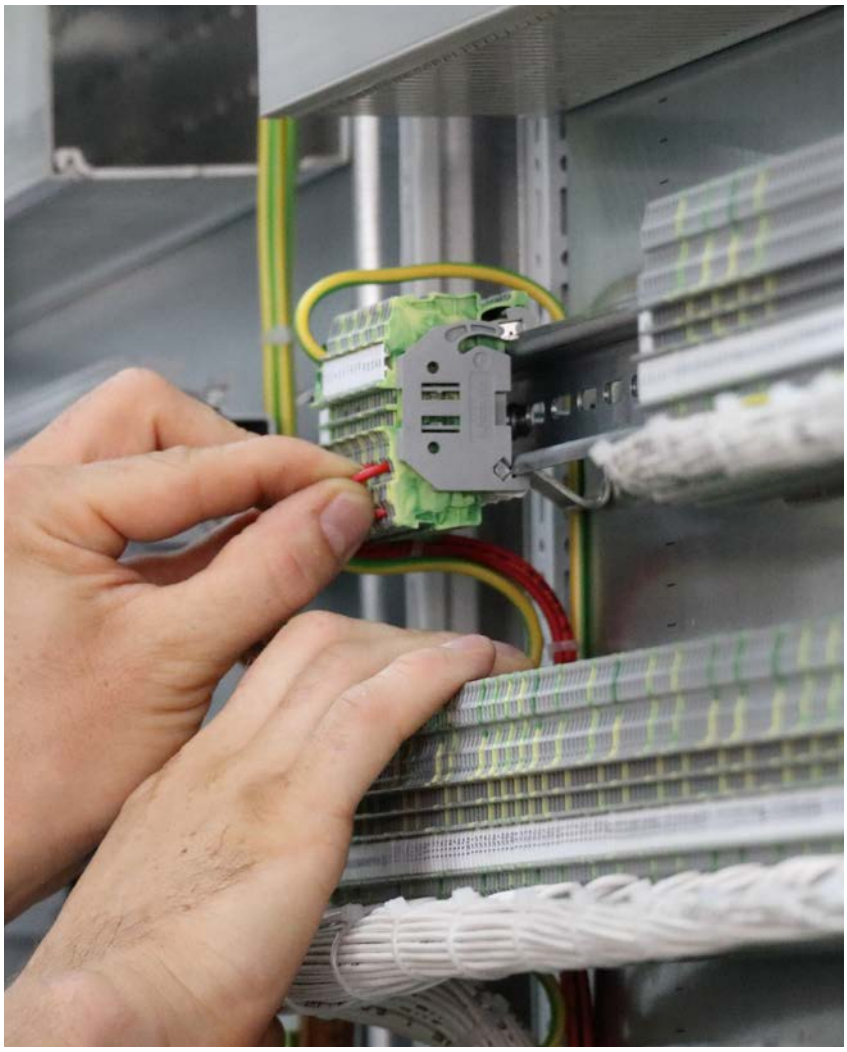
8
PE

among others, the filtration and refrigeration technologies, the automotive sector, various industrial sectors, including low voltage distribution boards up to 3200 A, and also, as previously, in building technology. Up to 1200 control cabinets are built in Amberg annually, with dimensions that extend from a wall cabinet, sized like an A4 sheet of paper, up to 20 meter long switch gear units. "The variety of applications that we serve offers our industrial customers an advantage: in addition to constructing the switchgears for their production, we are also involved in the construction of new production halls," according to Thorsten Jokiel. "Our customer always has the same company contact."

One Spring Clamp for All Applications

It is naturally also advantageous if the components used in the switchgears are also certified for all applications, like the TOPJOB®S Rail-Mounted Terminal Blocks from WAGO. Their spring pressure connection technology has the necessary certifications, so that JOKIEL can work everywhere in the world and in all applications using only this single rail-mounted terminal block system. JOKIEL has used TOPJOB®S for around ten years, and the switchgear manufacturer used other spring clamps from WAGO even earlier. "We were one of the first switchgear builders to use spring clamps," states Thorsten as he recalls, "the conversion from screw connections to spring pressure connection technology was a real milestone. For us, the spring clamps offered such relief during wiring, since there were no more screws to be tightened. And our customers have profited since then from the freedom from maintenance." Whereas the screws in screw clamps had to be regularly re-tightened, this labor was no longer necessary with spring pressure connection technology. "Thus, our customers could significantly reduce their maintenance expenses, while the connections remain fail-safe. In the meantime, spring pressure connection technology has been accepted by our customers and the clamps are now used in all sectors without reservations," according to JOKIEL.



Push-In Technology Saves Time During Wiring

With the conversion to TOPJOB®S in 2006, JOKIEL was able to save even more time during wiring the switchgears, "Thanks to the push-in technology, we can insert many conductors directly using these modules," explains Thorsten. Company wide, around 80% of the conductors have a nominal cross section of up to 2.5 square millimeters. All

»Thanks to the push-in technology, we can insert many conductors directly using these modules.«

For more than 30 years, JOKIEL GmbH and their 50 employees have designed and manufactured switchgears for building technology and for specialty systems.

conductors are provided with ferrules using a fully automated conductor assembly machine. "The wiring guides are automatically generated from the circuit diagrams and technical drawings designed in EPLAN," explains Jokiel. "Mounting plates, control cabinet doors, and housings are also bored and milled completely automatically on a CNC drilling center." He adds after a moment of thought, "at this consistency, we have already achieved what is currently understood by the expression Industry 4.0. This allows us to achieve fast throughput times and, thanks as well to our competent employees, a very high standard of quality. After all, our systems are used by our customers for multiple decades."

High Density Wiring in the Control Cabinet

For Jokiel, it is therefore natural to maintain the components used in their systems at state of the art levels. This was also true during the conversion from the "classic" spring clamps from WAGO to the TOPJOB®S, as Markus summarizes, "why should we stay with the old, when the new series offers only advantages, and none of the earlier disadvantages? Wiring is not only easier, thanks to the push-in technology, but the new modules also have an improved design. They are around 15 to 20% narrower, so that we can achieve a higher wiring density in the control cabinets."

30% Faster Marking

Markus Jokiel, who is primarily responsible for development and design of the systems, lists other advantages that WAGO's ***smart***PRINTER offers with regard to marking: using the thermal transfer printer allows generation of multi-line marking strips, which can be applied to several rail-mounted terminal blocks at once with a single hand movement. Due to the identical profiles of all TOPJOB®S Rail-Mounted Terminal Blocks – Jokiel uses 2- and 4-conductor I/O modules with other cross sections in addition to the 1.5 mm² modules – the marking can be applied consistently. Thorsten Jokiel explains, "I can mix different modules on one carrier rail and still mark them at the same level with one strip." Markus adds, "we use the ***smart***PRINTER primarily for our series production. For repeating switchgears, we have at the moment 27 different rail-mounted terminal

By using the ***smart***PRINTER, JOKIEL saves around 30 to 40% of their time when marking series production items.

blocks in reserve. By pressing one button, we can print the necessary marking strips. The time savings in contrast with conventional marking is surely around 30 to 40%."

Connecting a Larger Cross Section is Always Possible

He refers to yet another advantage of the TOPJOB®S Rail-Mounted Terminal Blocks: the high safety margins. All single-deck TOPJOB®S Rail-Mounted Terminal Blocks connect solid, stranded and fine-stranded conductors one size over their rated cross-section, without requiring special handling, and can be loaded with the nominal current of these conductors. "In practice, it occurs every once in a while that conductors with a higher cross section than originally planned are required for the external connections. With TOPJOB®S, I don't have to swap out my modules, but can simply connect, for example, a conductor with a nominal cross section of 4 mm² at a 2.5 mm² module," explains Markus.

"The products from WAGO offer synergies that support us in implementing our fast throughput times and our high standards of quality," is the conclusion from Thorsten Jokiel. "In addition, the delivery reliability is high and the delivery times are short, which is important to us, because we practice just in time manufacturing. WAGO is therefore basically the supplier for connection technology."

TEXT OLAF MEIER

PHOTO OLAF MEIER

THE NEW MASTER

PFC200 Controller now with PROFIBUS-DP Master Interface

The PFC200 controller family from WAGO has now been enhanced with a new PROFIBUS controller with DP Master interface. From now on, this compact controller can easily collect and process data in industrial environments via a PROFIBUS network with various subscribers. It thereby provides high speed communication with sensors and actuators in various machines and systems. In addition to the standard version, WAGO is also introducing the PFC200 with PROFIBUS Master interface, in a version designed for an extended temperature range of -20 to 60°C. This allows the controller to be flexibly used, particularly in industrial machines and in areas with higher requirements.

Simple Programming, Secure Communication

The new PFC200 controller operates with the Linux® realtime operating system and can be programmed using the proven WAGO-I/O-*PRO* configuration software based on CODESYS. GSD files can be read in very easily using the integrated PROFIBUS configurator. Sensitive production data is optimally protected at the same time by comprehensive security packages, such as SSL/TLS 1.2, SSH, VPN, and a firewall.

Proven Controller with Improved Hardware

The hardware for this tried and tested controller has been completely revised and optimized. The other controllers in the PFC200 family still use the familiar ETHERNET and CAN interfaces. The controller with the PROFIBUS DP Master interface also has a wide variety of approvals, allowing it to be used for nearly all applications. Nearly all I/O modules are supported by the typical 750 series local bus. In the meantime, the WAGO I/O line offers more that 500 modules. In addition to digital and analog I/O modules, it also includes many special modules for logging and processing highly varying signals.

Monitoring Low Voltage Switchgears

PLAYING IT SAFE WITH THE ENERGY SUPPLY

Julian Kübler is responsible for the facility systems at Schaeffler, at the Schweinfurt location.

When supplying electrical energy to production systems, safety plays a large role. In low voltage main distribution boards, circuit breakers are used most often to safely prevent excess currents and to switch off the power supply in the case of a short circuit. Monitoring systems is therefore particularly important to enable fast re-establishment of the power supply in the event of an interruption. Schaeffler, the industrial and automotive supplier, therefore uses fieldbus couplers from WAGO in their roller bearings production at their Schweinfurt facility.

During the production of roller bearings, a large number of different machines are used for cold-shaping technologies, forging, machining, heat treatment, and coating technologies. The company processes around 80,000 tons of steel annually at their Schweinfurt facility into roller bearing products for various uses – from automobile construction to wind power plants. Satisfactory electrical supply in diverse systems therefore represents the most important infrastructural foundation for Schaeffler.

Power Supply for Machines

There are correspondingly multiple supply lines from the medium-voltage network on the Schweinfurt facility grounds. They supply the transformer substation with just under 100 transformers, and these, in turn provide around 30 low voltage main distribution boards, which supply the power to the machines in the manufacturing halls. "The safety and reliability of the power supply is particularly important to us," explains Julian Kübler, who is responsible for monitoring the medium- and low-voltage transformers at the Schaeffler factory in Schweinfurt. Circuit breakers separately isolate the outputs for the electrical consumers in the systems. Each circuit breaker is thereby accommodated in a control cabinet in its own array. For consumers with lower power, several small circuit breakers are sometimes mounted in an array. A typical system consists of two to three regions with 15 to 20 arrays with a total output of up to 2000 kVA.

Remote Monitoring of the Circuit Breakers

During the set up of the low-voltage systems in 2015, a malfunction alarm was also included. Kübler describes the disadvantages of the old system, "Previously, the systems could only trigger a collective failure, which was then transmitted to the safety maintenance in the facility." A ring circuit thereby transmitted the alarm to all circuit breakers, so that it was impossible to determine remotely which outflow was actually affected. In order to ascertain precisely which circuit breaker had triggered the fault, the message outputs from all circuit breakers were sent to an additional control cabinet close to the system in a first approach. A controller processed the signals and forwarded corresponding messages to the control center. "The wiring expense for this solution was, however, extremely high," explains Kübler, "such that we looked into alternatives."

The Schaeffler employees from plant facilities struck it rich with WAGO. The fieldbus couplers and I/O modules from the modular WAGO-I/O-SYSTEM 750 are among the hardware that enabled a significantly more elegant solution for the fault message processing. In addition, each control cabinet array in the system was retrofitted with a PROFINET coupler. This includes a digital input module with 16 channels, which thus has sufficient capacity to evaluate all messages from the circuit breaker in detail. A central controller functions as the

»We only have to connect the coupler to patch cables from array to array.«

»Since we use a ring topology, the system functions even if a patch cable is interrupted.«

The fieldbus coupler and suitable input modules can be easily integrated into the control cabinet.

master in PROFINET and reads the signals from the PROFINET coupler: additional processing and the linkage to the control center functions exactly as previously. The use of the PROFINET coupler from WAGO has one essential advantage for Kübler, "We only have to connect the coupler to patch cables from array to array. Since we use a ring topology, the system functions even if a patch cable is interrupted." The cables are connected directly by internal channels in the control cabinet. Expensive wiring through the raised floor of the system is thus no longer necessary. As both the control lines and the power cables are guided through the common cable connecting compartment from the circuit breakers to the consumers, the respective outflows would have to switch voltage-free in order to lay the signal cables.

Alerts – Detailed and Around the Clock

The employees can monitor the status of all circuit breakers at all times from the control center, which is installed in the maintenance workshop. The status of the entire power supply is transparently visualized here. The new fault message system, which was previously installed in three of the low-voltage systems, provides significantly more functions than the previously used solution. In the case of a fault, the maintenance employees know which circuit breaker has been triggered and which malfunction is located where. The security center likewise receives more detailed error messages and can thus provide the on-call service workers with important information, even before they arrive at the facility. "In this way, we can increase the safety of our low-voltage power supply and thus the availability of our production systems," states Kübler happily.

Easy Retrofitting and Potential Expansion

In addition to the ease in wiring, another decisive advantage of the PROFINET coupler from WAGO is its compact dimensions. Kübler explains, "We could integrate them on the existing carrier rails in the individual control cabinets with minimal modifications." WAGO components can be connected into the existing electrical systems with equal ease.

The system can be flexibly expanded. There are already plans, for example, to switch the circuit breakers, which are currently controlled from the control center or on site using remote operations, via the central controller. The PROFINET coupler has to be expanded by one single corresponding digital output module for this purpose. "Remote switching has the advantage that the operator does not have to stand directly in front of the control cabinet in the case of a short circuit and the potentially occurring internal arcing," explains Kübler.

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WE INNOVATE!

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