automotion

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The B&R Technology Magazine

Optimized azimuth control

Less wear, more efficiency

Condition Monitoring High-availability wind power

Web-based HMI Lower maintenance costs with mapp View

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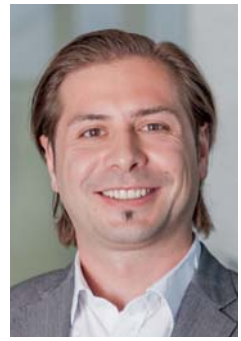


Dear Reader,

As a carbon-neutral source of energy, wind power plays a central role in efforts to hold global warming under the 2 °C mark. Already, we've seen the cost of onshore wind power drop below that of conventional technologies.

In many countries, conventional power plants are being replaced by wind farms to cover increasing demand. This will secure the continued growth of this industry in spite of any uncertainty in the economy at large.

Stable production quantities and continual improvements in efficiency promise to further reduce the cost of building and operating turbines. For this to be possible, however, wind power systems will rely on advanced engineering technology and innovative new approaches to control and monitoring.

Solutions for implementing Smart Factories, condition monitoring, remote access and robust motion control for turbines are just a few of the ways we open up enormous competitive advantages for our customers.

Come see them first hand at WindEnergy 2016 from September 27–30 in Hamburg (Hall B6, Booth B 6.393). We look forward to seeing you there!

Happy reading!

Peter Kronberger
Global Technology Manager – Energy

contents

Interview

Keep the turbines turning

Source: iStock

It may have taken a while, but condition monitoring has made its way to the wind power industry. Condition Monitoring Systems (CMS) increase the availability of wind turbines, prevent costly and dangerous failures, and ultimately make them both safer and more profitable. To find out how, we sat down with Bernd Höring, co-founder of 8.2 Monitoring.

Bernd, can you begin by telling us about the 8.2 Group and what it does?
Since it was founded in 1995, the 8.2 Group has grown into a network of 30 engineering offices all around the world, the majority of them in Germany. With a total of around 50 employees, our location here in Hamburg is the largest. We primarily deal with onshore and offshore wind farms, although over time our focus has widened to include all types of renewable energy. Today we're also strong in photovoltaics, biomass and grid integration. As experts in the field, we provide services ranging from technical inspections and damage analysis to online condition monitoring. We also offer a variety of consulting services. Essentially, 8.2 covers the entire renewable energy value chain.

The cooperation between 8.2 and B&R goes back a number of years. What was it that led you to B&R?
When we started working with B&R in 2013, it was important to us that we find a partner

What is condition monitoring?
Dynamic loads and severe weather take their toll on a turbine's drivetrain. If worn bearings, gearboxes or generators are not replaced in time, the result can be catastrophic failure and costly extended downtime. To keep things running smoothly for maximum availability and yield, turbines are equipped with condition monitoring systems (CMS) that provide a continuous stream of information about component health based on the vibrations caused by worn components.

where the chemistry is right. To me, that means building the relationship on openness and honesty. When you have that – like we do with B&R – working together is a pleasure. Equally important, the level of quality is on par with our demanding requirements. B&R has developed condition monitoring hardware that fits perfectly into our portfolio, while our services and analytical software complement B&R's portfolio.

Can you give us some background on how you came to co-found 8.2 Monitoring and your current role in the company?
Jochen Ziehmann, Dietmar Obst and I founded the company in 2010. Our skill sets complemented each other very well. I had always been involved with online condition monitoring in various industries, from petrochemicals and steel to wind power. Jochen Ziehmann is an outstanding software engineer, and had developed vibration analysis software. Seven years ago, Manfred Lührs, founder of the 8.2 Group, offered me the opportunity to join the organization. Having opened my own engineering office for condition monitoring in 2004, I felt that 8.2 would finally give me the chance to bring condition monitoring systems, or CMS, to a wider audience. Before, I had always dealt with specialty machinery, like a brown coal excavator or a tablet press for airbag explosives. In our role as independent experts within the 8.2 Group, our goal was to establish a portfolio of products and services for online monitoring. That included developing our own hardware-independent analytical software for online condition monitoring, as well as setting up an online monitoring center. Previously only the offline variant had been offered.

Why is condition monitoring so important for wind turbines?
Until 2002, wind turbines were plagued by unexpected failures – particularly in the gear teeth and bearings of their gearboxes and generators. This was partially due to a tendency to underestimate the highly dynamic loads and severe operating conditions, as well as the fact that they were only equipped with fairly rudimentary control instrumentation. With such high failure rates, insurance companies viewed turbines as a poor investment and were threatening to get out of the wind power business rather than operate at a loss. To get a handle on the situation, wind power companies leveraged existing condition monitoring expertise from industrial applications. In 2003, the Allianz Center for Technology (AZT) – followed shortly thereafter by Germanischer Lloyd (GL) – published guidelines for the certification of condition monitoring systems (CMS). These systems allowed for early detection of wear so that components can be replaced before they cause more serious equipment failure. As a result, rather than €150,000 in repairs, a company might only be looking at €10,000.

What are the potential downsides to using a CMS?
There aren't any. I do know a few farmers who operate turbines, and their well-trained ears prick up immediately when something isn't running smoothly. Wear and tear is generally accompanied by vibrations and noise, after all. That's the exception though. These days, the operator is normally sitting in front of a computer screen at a big monitoring center and has only process data to go by – so simply listening for damage is not an option. Here, it's the CMS that gives you an ear on the machine.

Where is the market headed with regard to condition monitoring?
We're currently working primarily with standard CMS applications that operate independently of the turbine controller. This is going to shift in favor of integrated systems now that the necessary automation hardware is available. By incorporating additional process parameters and system-level monitoring, these solutions will deliver better results. Controller-integrated systems will likely also be able to meet the same quality standards for cheaper. Industry 4.0-related topics such as cloud computing, digitalization and big data are also important.

As requirements for availability and yield stability grow more rigorous, the market for condition monitoring will benefit. In Germany, offshore wind farms are already

How does condition monitoring work at B&R?
B&R's easily configurable condition monitoring modules provide reliable and precise wear detection for efficient predictive maintenance. As part of the X20 control system, they can be used freely in any control topology. A special feature of these modules is that they perform vibration analysis locally on the module – providing fully processed condition parameters for easy integration. In combination with analysis software like VibraLyzePRO from 8.2, they allow effective online monitoring of complex systems. These results also provide detailed insight into the system mechanics, allowing existing processes to be optimized with maximum efficiency.

required to be equipped with a CMS. Even onshore, as turbines are built larger and larger, the consequences of a failure become more serious. That's why almost all wind turbine builders are including a CMS as standard equipment on systems larger than 2.5 megawatts. The international market – in China, for example – is growing as well. This will in turn ramp up the pressure on manufacturers to minimize lifecycle costs and eliminate risk factors. Paired with the corresponding independent analysis service, a CMS can play a key role in meeting these challenges.

Many companies approach topics like cloud computing with hesitation, worried that they may pose a security risk. Where do you stand?
It's certainly an area we're looking at. Our own server is located here in Hamburg because performance is a top priority for us – but our capacity is not unlimited. Far from being a liability, I think a cloud solution is actually the more secure option. Often it's the in-house server that represents a greater risk in terms of data loss. In my opinion, the level of data security you get from a larger cloud computing service provider is going to be more advanced and kept up to date better than what a smaller company is able to manage on its own. Cloud performance is also constantly improving.

Is wind power going to develop into a mass market for condition monitoring? What's your prediction?
For well-established CMS companies it already is a mass market – every turbine manufacturer has a CMS supplier. Industrial applications are still the bread and butter for the majority of CMS suppliers, however. They've been there for decades and have plenty of satisfied customers. It really depends on how well controls suppliers like B&R are able to gain a foothold in the wind sector. If they are successful, the cost of CMS hardware will drop and it will become a standard component of turbine automation systems.

The advantage that automation providers have is that, since they operate all the interfaces, they're in a position to meet the requirements of customers who want to make information available to other software systems. It will be another five to ten years before we see that happen, however. With all its technical advantages and new developments, we mustn't forget that condition monitoring is still an area where the experienced analyst plays an important role. ←

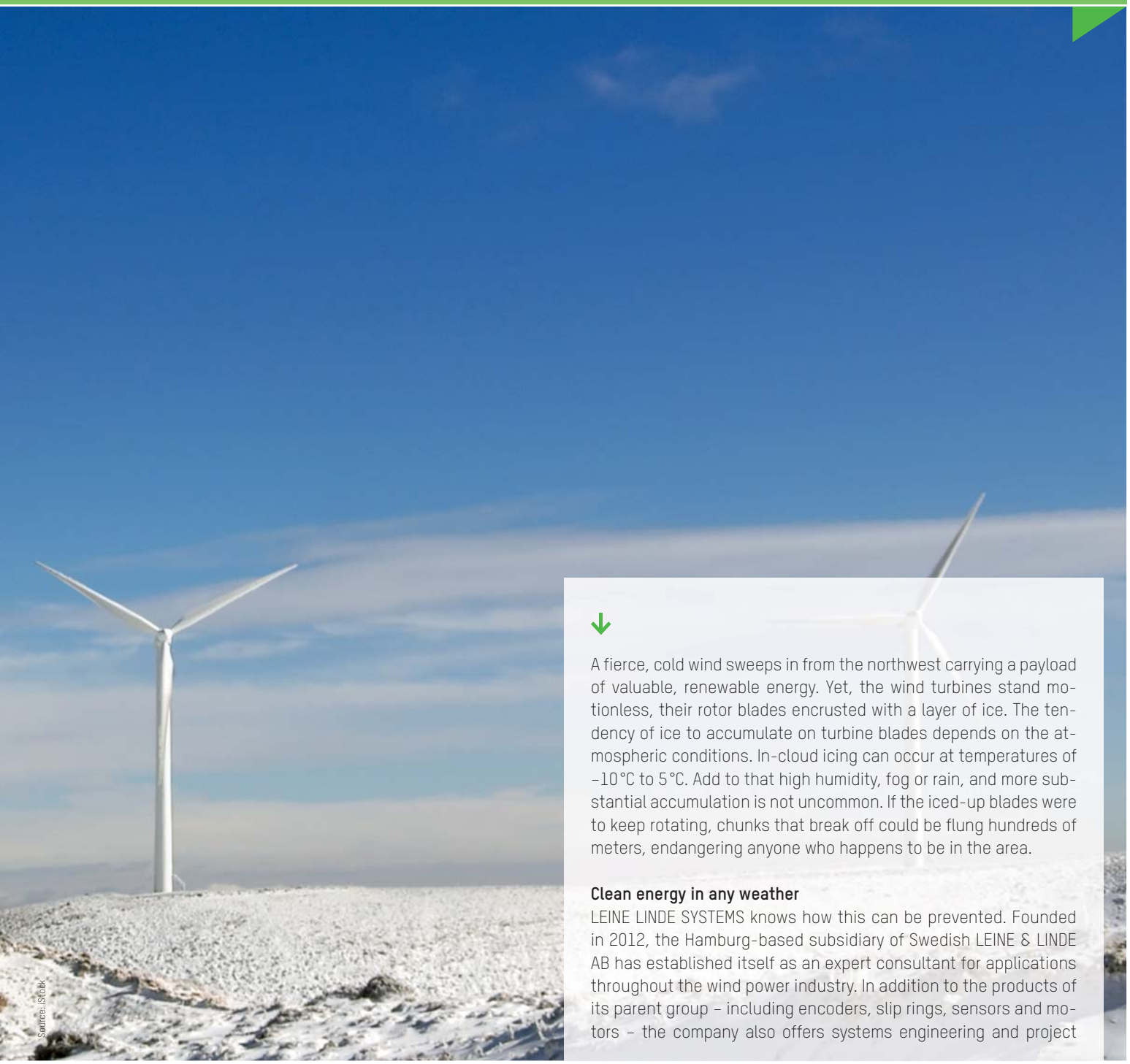
Bernd Höring
CEO and Condition Monitoring Expert,
8.2 Monitoring GmbH

"It was important to us that we find a partner where the chemistry is right. That means building relationships on openness and honesty. Our quality standards are as demanding as our technical specifications. That's why we needed a well-established supplier like B&R who can meet these requirements all around the world."

Wind power

A bright forecast for icy blades

Germany gets more of its renewable energy from wind power than any other source. Both onshore and off, wind farms have faced immense pressure to innovate. Systems need to be designed and built to withstand dynamic loads and severe weather year after year without failure. Particularly in the winter months, ice accumulation on the blades has been a notorious source of unscheduled downtime. Accepting the challenge, LEINE LINDE SYSTEMS just needed to find the right partner to implement its plans: B&R.



Source: iStock

A fierce, cold wind sweeps in from the northwest carrying a payload of valuable, renewable energy. Yet, the wind turbines stand motionless, their rotor blades encrusted with a layer of ice. The tendency of ice to accumulate on turbine blades depends on the atmospheric conditions. In-cloud icing can occur at temperatures of –10 °C to 5 °C. Add to that high humidity, fog or rain, and more substantial accumulation is not uncommon. If the iced-up blades were to keep rotating, chunks that break off could be flung hundreds of meters, endangering anyone who happens to be in the area.

Clean energy in any weather

LEINE LINDE SYSTEMS knows how this can be prevented. Founded in 2012, the Hamburg-based subsidiary of Swedish LEINE & LINDE AB has established itself as an expert consultant for applications throughout the wind power industry. In addition to the products of its parent group – including encoders, slip rings, sensors and motors – the company also offers systems engineering and project

Ralf Düllmann
CTO, LEINE LINDE SYSTEMS

"Our partnership with B&R has been built with long-term sustainability in mind. We had a clearly defined goal of avoiding the use of multiple systems – instead relying on a go-to partner for the entire solution. B&R has been a perfect fit since the very beginning."

management services for wind power applications. The most significant wind power markets are currently found in Europe, China and South America.

To develop its new IPMS ice prevention system, LEINE LINDE SYSTEMS needed to find a supplier for a compact control solution. Feedback from elsewhere in the parent group reported very positive experiences with B&R, and B&R controllers already offered interfaces for the group's EnDat sensors, so the decision was quickly made.

During development of the IPMS, LEINE LINDE SYSTEMS worked together closely with the team at B&R's Hannover location, from the preparation of the functional and design specifications to the selection of the ideal B&R X20 controller and I/O modules. "Our partnership with B&R has been built with long-term sustainability in mind. We had a clearly defined goal of avoiding the use of multiple systems – instead relying on a go-to partner for the entire solution. B&R has been a perfect fit since the very beginning," says Ralf Düllmann, CTO of LEINE LINDE SYSTEMS.

When the conditions are right

The IPMS system is designed to detect and prevent the accumulation of ice on wind turbine rotor blades. The problems with ice range from unevenly distributed weight that brings the turbine out of balance to the safety hazard known as "ice throw" when blades shed their ice mid-rotation. To counter these effects, the IPMS system monitors a specific set of meteorological parameters and alerts operating personnel if the conditions pose a risk of ice accumulation. A network camera installed in the system allows operators to view the situation remotely using a smartphone or PC and either shut the turbine down immediately or have an automatic shutdown triggered by defined alarm levels.

The key advantage of the IPMS system is that it provides early detection of ice-causing conditions. Shutting turbines down before ice accumulates helps minimize lost yield because it is no longer necessary to wait for the ice to melt before resuming operation. It also opens up options for reacting to different situations, such as stopping rotation to avoid collecting additional moisture or switching on a blade heating system in advance.

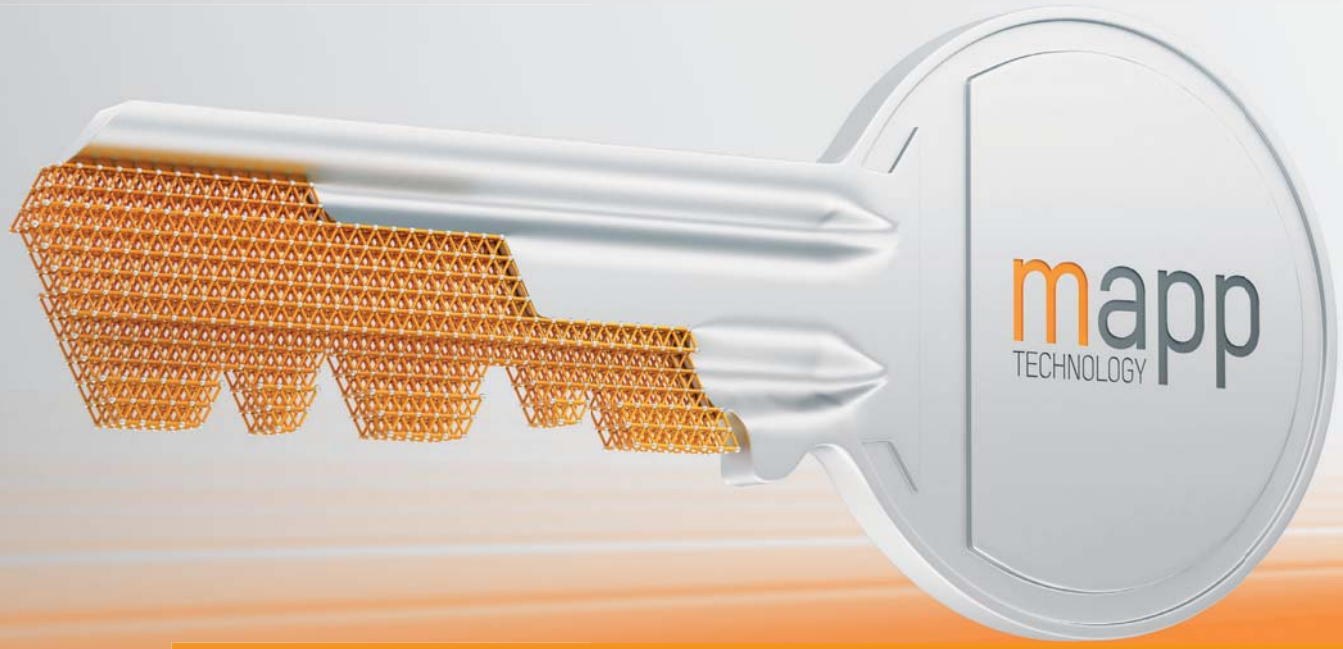
"In most cases, regulations or operating licenses require a visual inspection to confirm that the blades are free of ice before the turbine can resume operation. This is typically handled by an employee on site, but with IPMS the verification can be performed remotely. That saves time and money," explains Matthias Finke, senior product manager at LEINE LINDE SYSTEMS.

Trends in wind power

The industry trend is towards taller turbines with longer blades. As wide open spaces grow scarce, turbines are increasingly being placed in weak-wind areas, ports, industrial zones and woodlands – where safety plays an even more prominent role.

Rather than simply building a scaled-up version of an existing installation, new turbines are being completely redesigned with more extensive sensor technology and more efficient use of construction materials to maximize both availability and safety.

In 2015, Germany generated more electricity from wind power than nuclear power for the first time in history. By 2025, the country aims to further increase the share of electricity generated from renewable sources to at least 40%. In the long term, offshore wind farms alone are expected to supply the grid with around 15,000 megawatts. Today, wind power accounts for more than 9% of the electricity produced in Germany. ←



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- Increased software quality
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Interview

Substantial potential for optimizing azimuth control

Yaw systems that allow wind turbines to track wind direction subject them to unnecessary mechanical stress and accelerated wear. B&R's Peter Kronberger and Alois Holzleitner are convinced that a more sustainable approach is possible.

Yaw systems rotate turbines into the wind in order to maximize energy yield. This generally results in increased mechanical wear, but an intelligent servo drive like the ACOPOS P3 can make a big difference.

The robust construction of B&R's ACOPOS P3 servo drive makes it ideally suited for offshore applications. The P3 also provides feedback about the system that can be used for remote diagnostics and predictive maintenance. Printing

Yaw systems rotate turbines into the wind in order to maximize energy yield. Peter, you've called conventional approaches outdated. What do you mean by that?
Peter Kronberger: The head, or nacelle, of a wind turbine is typically rotated by four to eight motors. This is known as a yaw system, and the process is called azimuth control. The motors are typically controlled by a soft starter or a frequency inverter. With the head of an offshore wind turbine often weighing over 500 tons, the yaw system is subjected to substantial mechanical wear, which inevitably leads to downtime and costly service. Additional mechanical stress comes from the hydraulic brake that holds the nacelle. This brake is only partially disengaged during yaw adjustment to prevent uncontrolled movements in crosswinds.

What alternatives would you suggest?
Kronberger: Intelligent servo drives offer substantial potential for optimizing azimuth control. Advanced torque control, for instance, can reduce the levels of torque experienced by mechanical components. Then you have backlash compensation, which prevents the impacts that otherwise occur between gear teeth when the turbine changes direction. When you have the problem of wear under control, you're able to re-adjust the nacelle more often. That means a boost in both availability and yield.

Are there servo drives that can handle the harsh offshore conditions?
Alois Holzleitner: Absolutely. Our new ACOPOS P3 servo drive is exceptionally rugged. Variants are available to control from one to three axes, and they are all designed to handle the environmental conditions found in a wind turbine. They've been tested for continuous vibrations up to 1 g, and the circuit boards are fully coated to ensure flawless operation even in humid, salty air. Servo drives have some other very important advantages, though.

Such as?
Holzleitner: Our servo drives provide helpful feedback about the system, which can be used not only for azimuth control, but also for remote diagnostics. Temperature and current values as well as error logs are stored automatically and can be read remotely. Among other benefits, this allows for optimized maintenance. And let's not forget the aspect of safety. The P3 variant featuring B&R's safety technology provides safe torque and position values up to PL e. If you utilize this information, you no longer need the cable twist sensor that is used in a conventional system.

Alois Holzleitner
Technical Manager – Motion, B&R

"Using our ACOPOS P3 servo drive helps increase yield, reduce wear and improve availability."

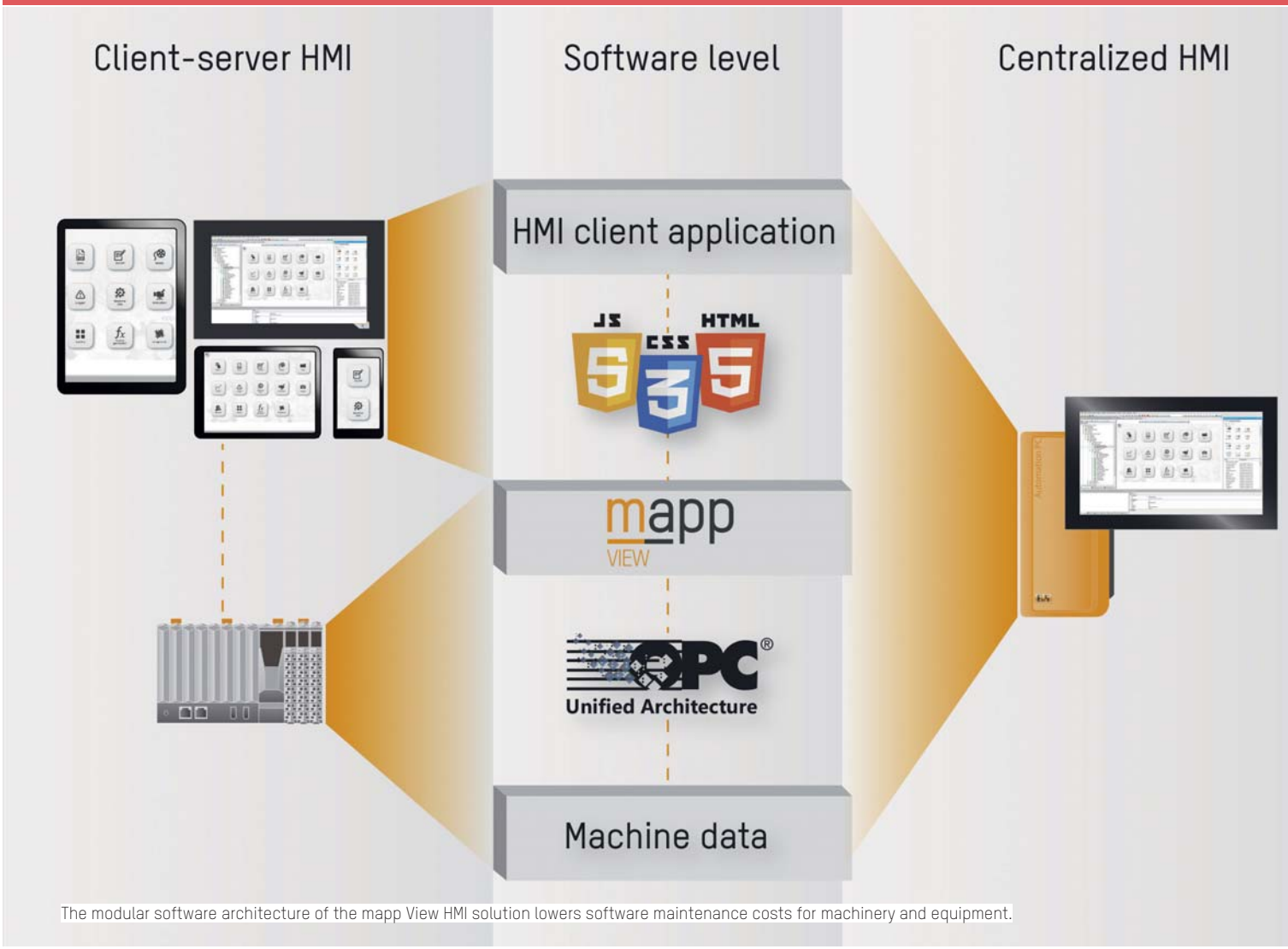
Peter Kronberger
Global Technology Manager – Energy, B&R

"Intelligent servo drives offer substantial potential for optimizing azimuth control."

How complicated is the process of converting to a servo solution?
Kronberger: It's much easier than you might expect. All the components are off-the-shelf products, and the ACOPOS P3 can be used with any servo motor. Essentially, all you need to do is replace the soft starter or frequency inverter with a servo drive for the required number of axes. With relatively little effort, you get a big payoff in terms of yield and availability.

mapp View

Minimizing maintenance costs



The modular software architecture of the mapp View HMI solution lowers software maintenance costs for machinery and equipment.

"Over the course of a machine's service life," explains Wolfgang Portugaller, head of B&R's system architects, "you spend far more on adapting and maintaining the software than you did to develop it in the first place." On top of direct costs for things like on-site service calls, secondary costs can quickly add up when a machine or an entire line needs to be shut down, or when a software update introduces new errors into the system. In their attempts to lower the total cost of ownership, OEMs are seeking ways to make software easier and less expensive to maintain.

Modern software architecture

Today's more advanced software architectures make it possible to decouple the HMI application from the machine's control logic. "Conventional HMI solutions are tightly interlinked with the machine application," explains Portugaller. "That means that if you make a change to the control logic, you also have to update the HMI application. Conversely, if you redesign the user interface to be more friendly, you also have to adapt the control logic."

Once a machine and its HMI application are operational, even a minor adjustment can have major consequences. Entire production lines are halted while the software developer – who had to make an extra trip for the call – attempts to get the machine's software running again. An effective way to keep maintenance costs from getting out of hand is with modular software. Applications whose functions are encapsulated in modular elements are considerably easier and less expensive to maintain.

To display the value of a certain process variable, for example, the variable itself would often be linked directly to the corresponding UI element. And that's no problem at all – as long as the machine runs unchanged for 20 years. "Unfortunately, that is hardly ever the case," says Portugaller. Process variables are renamed; UI screens are rearranged; new users are added. Even a small adjustment can often call for a surprising amount of reprogramming.

One way to alleviate this problem is by following the software design principle of separation of concerns (SoC). In the context of HMI software, SoC means maintaining a clear separation between the layout of UI screens and the data to be displayed on them.

Data exchange via OPC UA

"We applied this principle rigorously to every aspect of our new mapp View HMI solution," explains Portugaller. For communication between the control and HMI applications, mapp View relies on the independent OPC UA standard. To display a temperature value, for instance, the HMI application doesn't query the process variable in the control application, but rather the value provided by the OPC UA server on the machine's controller.

Reduced potential for errors

"The advantages of this type of architecture become particularly evident," notes Portugaller, "when it comes time to reuse one of the components, build a new variant of the machine or implement changes during maintenance." To modify the range of values for a process variable – even one that is displayed on 10 different UI screens – you just have to make the change once on the OPC UA server. This virtually eliminates the potential for copy-andpaste errors or overlooked instances.

There is also one very important benefit to using OPC UA. Rather than simply raw data, it also provides contextual information in the form of metadata. For a temperature variable, this means that you get not only a numerical value, but also the physical units you need to interpret it, so there is no chance of conversion errors. The units can be changed with a simple click or tap on the UI screen, regardless of which units are used in the control application.

Change setpoints safely

The ability to transmit value limits is also very helpful. The UI immediately alerts operators if they enter a setpoint outside of the permitted range, so there is no need to query the control application explicitly. If a maintenance technician adds a new coolant, the setpoints in the control application are adjusted automatically, and the OPC UA server on the machine's controller automatically provides the changed data to the HMI application.

Manage access easily

"Access rights are another important topic related to setpoint changes," adds Portugaller. Information about which roles are permitted to change which values is included along with the OPC UA metadata. B&R's role management system makes it easy to define and manage roles, access levels and users. "At runtime, you're free to add users and assign them a role whenever you want. There's no need to make changes in the role management system itself."

B&R first introduced mapp View at the 2015 SPS IPC Drives. The HMI solution is an optional component of the Automation Studio engineering software available with Version 4.2.5 LTS or higher. Pilot customers have been using mapp View for about a year now, and the first machines are already being used and maintained. "Our customers are thrilled about how easy software maintenance is with mapp View," says Portugaller. "They are surprised to see just how large of an impact the architecture of their HMI software can have on the total cost of maintaining their machinery and equipment." ←

Wolfgang Portugaller
Head of System Architects, B&R

"Our customers are thrilled about how easy software maintenance is with mapp View."

Product overview

Innovative technologies and products for the energy industry

SIL 3 / PL e / CAT 4

Groundbreaking safety technology
B&R's extensive portfolio of integrated safety technology facilitates streamlined, cost-optimized safety applications.

- Digital and counter inputs
- Digital and relay outputs
- Switching potential groups
- Analog and temperature inputs for PT100/1000 and temperature sensors

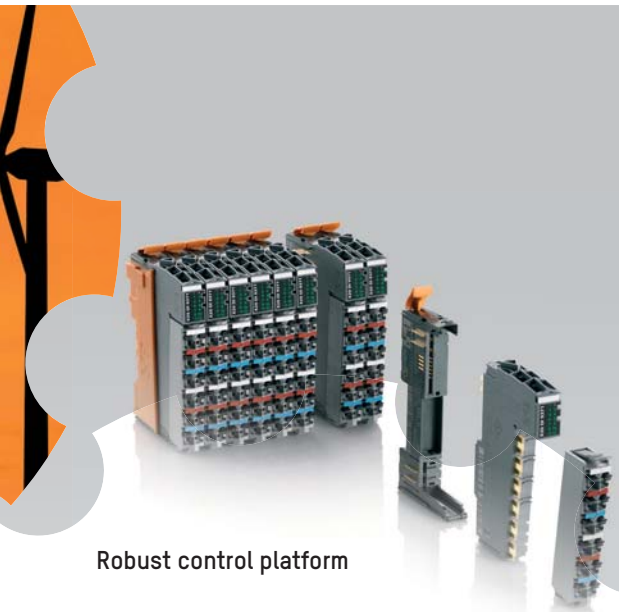
All modules have been certified to comply with the highest safety levels: SIL 3 per IEC 61508 and PL e per ISO 13849. Situation-dependent safety reactions with ultrafast response times in the 10-millisecond range help to optimize processes and mechanical components and save costs.

Remote access features allow for remote maintenance and restart authorization to be performed from a service center.

mapp TECHNOLOGY

With mapp Technology, B&R shortens software development times by an average of two-thirds. This is made possible by intelligent software blocks that encapsulate frequently occurring basic functions.

Your software engineers will be able to dedicate much more time to optimizing the core process. Since B&R takes on the responsibility for ongoing maintenance of these blocks, you'll enjoy both improved software quality and reduced maintenance costs.



Robust control platform

B&R's robust X20 control platform satisfies all of the environmental requirements typically encountered in the energy industry.

The series offers an expanded temperature range from -25°C to +60°C and is certified by Germanischer Lloyd for maritime use in accordance with environmental categories D and EMC1.

Coated versions of X20 modules are available for situations where they will be exposed to condensation, corrosive gases or salt air.

Data management and O&M

APROL Process Data Acquisition (PDA) is a ready-to-use solution for real-time acquisition of operating data.

The flexibility of APROL PDA makes it possible to connect many different data sources in a variety of topologies. At the same time, the control computer is able to execute logic.

Open interfaces allow 3rd-party integration and help future-proof the system by making it easy to adapt and expand.

The unprecedented scalability accommodates systems ranging from 50 to 500,000 data points.

Telecontrol

IEC 60870-5-101, -104
IEC 61850*, IEC 61400-25*
*in development

Open interfaces

The only future-proof solution is an open solution. Openness allows you to work with the tools you are most comfortable using. It allows machines to communicate effortlessly with external systems, and by facilitating the reuse of existing software for future solutions, it frees up valuable time to get your product to market faster. B&R offers openness on all levels and in all products.

Full redundancy

The many different redundancy options satisfy the heightened requirements of high-availability systems. Optimal solutions can be tailored to specific requirements using cost-effective standard components.

Printing

Machine development with minimal risk

As software comprises a larger and larger share of each new generation of machinery, OEMs are encountering challenges that can no longer be solved efficiently using conventional approaches to software engineering. Swiss printing press manufacturer HAPA found a successful answer to these challenges with technology from B&R. Using mapp Technology, the company has substantially reduced the time it takes to develop and test the control application for its presses, while at the same time making them more flexible and more reliable.

Even without all the talk surrounding the Internet of Things and Industry 4.0, most machine builders are well aware of the contribution that software technology can make to the success of their companies. After all, as software plays an increasingly dominant role in each new generation of machines, so too grows the impact of programming errors, overly complex software structures and incompatibility. The total cost of developing, testing and maintaining a software solution escalates quickly with every change – whether the result of customer-requested modifications, integration into a production line or supervisory-level software system or even just normal upgrades over the lifecycle of a machine generation.

Machine variants caused excessive overhead

"In the past – whether due to insufficient modularity, custom adaptations or different approaches taken by different programmers – each machine solution behaved somewhat differently, despite having the same core technology, such our printhead," recalls HAPA CTO Jean-Luc Devenoge. "That inflated development costs and made user training and machine maintenance more complicated." As Devenoge has experienced, even firmware can become problematic over time. When a hardware component is replaced, conflicting software versions can even bring down a machine.

"We need to take a cue from the field of IT and use advanced software engineering technology to minimize the risks faced by manufacturers and users of machinery during development and operation," Devenoge has long been convinced. "That means working with frameworks and creating reusable software. It also means doing unit testing and managing the firmware of lower-level components centrally on the controller."

Minimizing risk during machine development

Kicking off development of its first dedicated film and label printing

The HAPA 862 film and label printer uses advanced software engineering, including mapp Technology, to allow industrial users to react quickly and flexibly to changing market and regulatory conditions.

Based on a custom B&R panel – the award-winning HMI is exceptionally intuitive to use. In the background, an Automation PC 910 from B&R provides a powerful hardware platform able to handle the most complex image processing tasks with ease

Jean-Luc Devenoge
CTO, HAPA AG

"mapp Technology and B&R's complete portfolio of automation products make it possible to design machines that are both more flexible and easier to use. At the same time, they help minimize the risks involved in developing and operating new machines."

system in mid-2013, the Swiss printing specialist left no stone unturned. From the housing and machine frame to the controller, HMI panel and printing module – everything was developed from scratch.

"Our goal was to make the machine more flexible and user friendly, while at the same time minimizing risks for both ourselves and our customers," summarizes the CTO. That explains the long list of specifications on which Devenoge's team based its evaluation of potential automation partners.

Like its predecessor, the new controller would need to be able to distribute firmware to connected components at startup in order to prevent malfunctions due to version conflicts. "We had all the big name suppliers on our list, but this was one of the criteria that only B&R could deliver on," recalls Devenoge.

Minimizing risk with well-tested mapp components

The automation specialist also scored favorably in HAPA's evaluation with its software framework, mapp Technology. "In the past, we have generally written our own code for many of the low-level requirements such as error handling and communication between blocks," reports Devenoge. "With the introduction of mapp Technology, B&R has taken this work off our hands, allowing us to devote our time to implementing functions that are specific to our machine."

HAPA is among the first users to implement components such as mapp AlarmX. This component provides central management and configuration of every alarm in the system – even alarms from mapp components added to the project later on. Alarm notifications can be sent via text message or email, or used to trigger certain actions – such as playing a video or opening a PDF help file.

Unit testing prevents unexpected errors

"One of the decisive aspects of mapp its use of state-of-the-art development methodology. Each component is subjected to module testing as well as being accompanied by diagnostic functions that allow it to be checked again in the context of unit testing," says Devenoge.

Not only does this make the software more reliable, it makes it easier to meet GAMP 5 requirements. This is a key point for HAPA,

Source: HAPA

The integrated "redcube plus" module prints up to four spot colors or CMYK. A POWERLINK interface ensures optimal connectivity.

since many of its printing machines are purchased by pharmaceutical companies. "If you use an unmodified mapp component more than five times, it already meets the requirements of GAMP 4," Devenoge explains. "That greatly simplifies the GAMP 5 process, since all that's left to validate is the higher-level state machine that controls all the mapp components."

Distributed development and know-how protection

Yet, mapp Technology has much more to offer, as HAPA's CTO points out: "Another huge advantage of this technology is that, by encapsulating functionality and providing uniform communication and error handling among the mapp components, it allows multiple developers to work concurrently on the same project." This also allows certain programming tasks to be outsourced without revealing the inner workings of the machine in unnecessary scope or detail.

mapp Technology also makes it easier to implement customer-specific solutions, since the software automatically adapts to match the configuration of the machine. "All that remains is to compile the application, and the machine is up and running without having to write or modify a single line of code," praises Devenoge. "As mapp Technology is used in more and more applications, the mapp components can even be reused for different machines." HAPA is currently taking advantage of this in the development of its brand new blister printing machine.

Integrated B&R solution prevents problems

HAPA has made its latest machine so modular that the same printing module, called "redcube plus", can be used whether it is printing on cartons, blister foil or capsules. It is also scalable up to seven spot colors. The integrated control electronics feature a POWERLINK interface for easy integration into the automation solution. "Thanks to the FPGA solution and the open source code, implementation of the interface only cost us two days of work," notes Devenoge.

Designed as an in-house industrial printing solution, the HAPA 862 relies on a B&R X20 control platform – regardless of whether it's the top-mounted (inline), stand-mounted or roll-to-roll (offline) variant. HAPA selected B&R solutions for every other automation task as well – from stepper and servo motors to ACOPOS-multi servo drives and X67 stepper motor modules to a SafeLOGIC safety controller, an Automation PC 910 and a custom-designed Automation Panel.

"Having such a broad spectrum of products at our disposal from a single source was important to us," explains Devenoge. "It gives us the assurance that we won't have any issues with interfaces or with the interaction between the controller and drives when we go to develop or modify a machine. It also ensures that project responsibilities are clearly defined." High-quality support was also a major criteria for HAPA. "When you're developing something from the ground up, like we did with the HAPA 862, and using various technologies for the first time, being able to rely on the support of your automation partner is absolutely critical," emphasizes the HAPA manager in conclusion. "We asked a lot of other companies about their experiences with controls suppliers. The clear consensus was that B&R does support right. And they certainly proved that over the course of our project." ←

Biomedical engineering

Life-saving quality

Fresenius Medical Care researches and develops medical equipment used to extract harmful substances from the blood of critically ill patients. In search of a state-of-the-art new control solution for its inline steam sterilizer, Fresenius found what it was looking for at B&R.

The adsorbents that Fresenius Medical Care produces are the key to the apheresis procedure.

Just in time, a heart attack patient arrives at the hospital and receives emergency care that saves his life. Following his initial recovery, however, efforts to treat his elevated cholesterol with diet and medication are unsuccessful. To minimize the risk of a subsequent heart attack, doctors would have to extract LDL, commonly known as "bad cholesterol", from his blood using a process called apheresis. Similar to the more familiar dialysis procedure, apheresis is used to remove LDL cholesterol and other harmful substances from the blood of patients suffering from severe lipid metabolism disorders. The process of cleansing the blood outside the body relies on adsorbent materials that selectively bond pathogenic substances as the patient's plasma is passed through the device.

Life-saving blood cleansing: Maximum correction of a risk factor
A specialist in this type of therapy is Fresenius Medical Care. At its location in Krems, Austria, the company develops adsorbent materials for LDL apheresis, medical devices for renal replacement therapy and treatment of autoimmune disorders, as well as performing research into innovative new therapies.

New Fresenius Medical Care partner: B&R
To continue meeting the strict requirements of medical equipment with outstanding quality and performance, Fresenius Medical Care sought an absolute state-of-the-art control solution for its filling station and inline steam sterilizer – equipment that had been custom-designed for the production of adsorbents for LDL apheresis.

After evaluating numerous systems engineering companies, Fresenius awarded the task of replacing the control and logging system to Geminos. The selection of B&R for the control technology was based on Geminos' history with B&R as well as positive reports from Fresenius' sister companies.

B&R tool shortened development time
The requirements were clearly defined – the production process needed to be designed so that the automation system could both ensure fully automated production and make the lifecycle traceable to keep the supply chain running. Prior to implementation, the

Johannes Durhofer
Production & Logistics, Fresenius

"Our decision to go with B&R was based on their history with our systems engineering partner, Geminos, as well as the very positive experiences of our sister companies."

Fresenius relies on B&R for state-of-the-art control components.

new system would also have to be validated by an external company in order to comply with the pharmaceutical industry's strict quality standards. For this, Fresenius selected the company Anapur, who possesses the necessary resources and know-how for risk analysis and other requirements.

In June of 2015, the control and logging systems were retrofitted with B&R technology. The processing technology and pipeline system were in good condition and remained largely unchanged, whereas the software, control electronics and pneumatic systems were completely rebuilt from the ground up. B&R's APROL and Automation Studio software solutions were used. The APROL trend system provides long-term data archiving, while the seamlessly integrated business intelligence suite from Jaspersoft provides batch-level reporting and analysis. To improve data security, the tamper-proof databases that hold the collected process data are stored on an external network, which in turn is linked with the APROL archiving system.

"In the instrumentation cabinet, a network of 65 temperature and pressure sensors communicate with the main controller via POWERLINK using external bus nodes from B&R. This decentralized layout minimizes wiring between sensor and I/O module. And, with APROL operated via a conventional network interface, you don't need a dedicated network for data transfer and can instead use the existing IT infrastructure," explains Geminos engineer Martin Morgenbesser.

Tight schedule for project implementation

"The project started in January of 2015, and needed to be completed only six months later. Any longer, and there would be production delays. Already operating at full capacity, we wouldn't have been able to make up for the lost output by the end of the year," explains Durhofer. "Our primary goal was to complete the project in six months, but another big topic for us was long-term support."

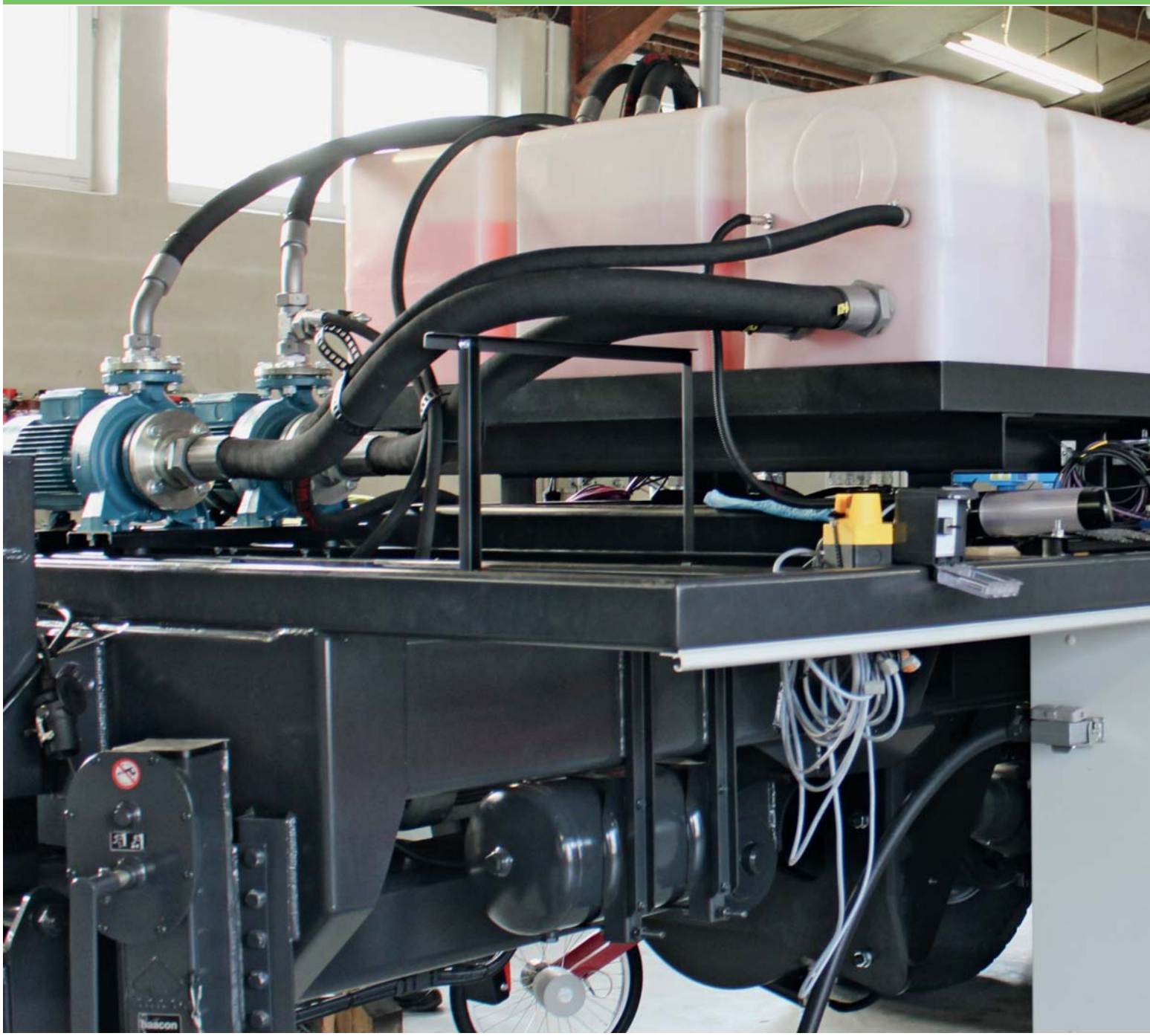
With B&R and Geminos, Fresenius now has two reliable partners at its side. ←

Martin Morgenbesser
Engineer, Geminos Anlagenbau

"The tools that B&R offers help drastically reduce development times. That allows us to dedicate more time to optimizing the source code and performing more detailed, extensive testing."

Agricultural equipment

High-speed bus for precision braking



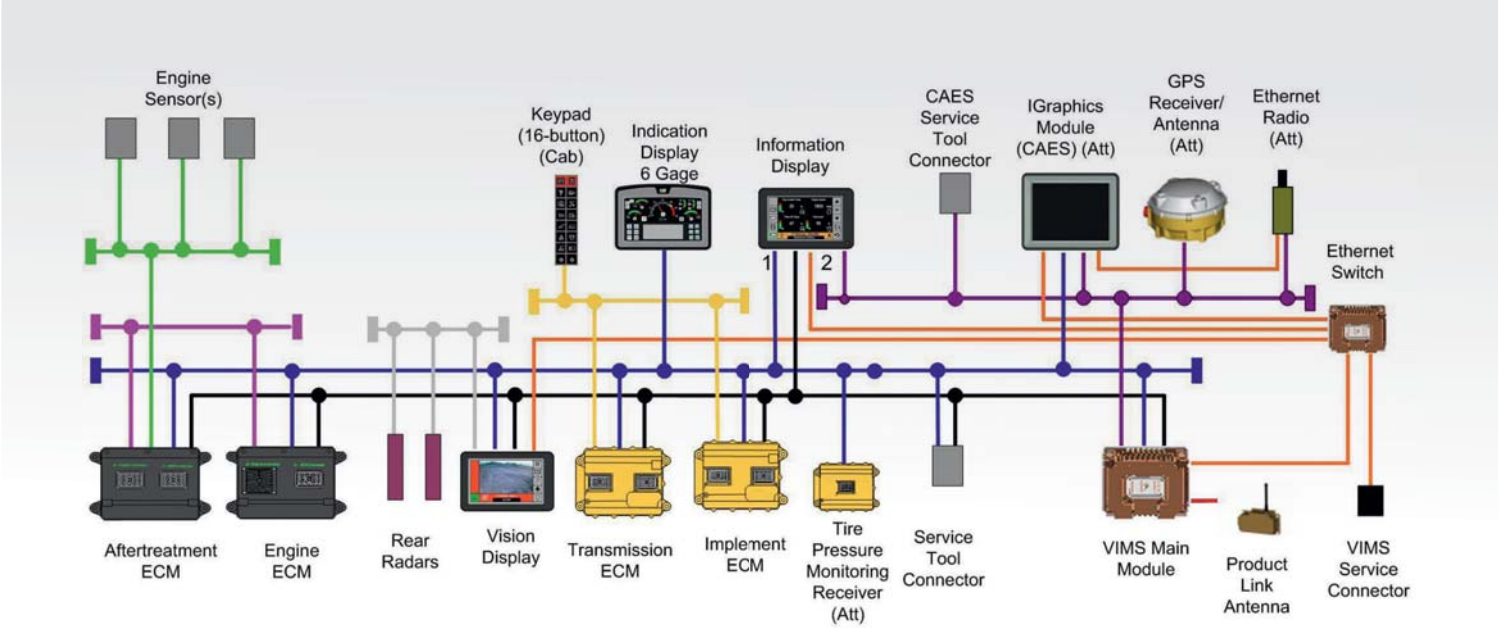
Today's agricultural equipment is so heavily automated, the cab of a modern tractor might almost be mistaken for a high-tech control room. The volumes of data being processed demand a level of performance that traditional bus systems are no longer able to offer. For its newly developed load car, enders was looking for a communication protocol able to meet the special demands of agricultural equipment – and they found it.

Nearly every automobile manufacturer is tinkering with some form of self-driving technology, and the first rounds of real-world testing have made headlines throughout the industry. For agricultural vehicles, on the other hand, autonomous driving technology is already a well-established reality. As a modern tractor moves across the field, it is often steered by the implement it is towing – requiring the driver to do no more than supervise the process. A potato harvester, for example, detects the ridges in the field with integrated sensors and sends commands to the tractor so that it follows them automatically without any steering on the part of the driver.

The harvester also calculates how fast it needs to move in order to optimize its capacity utilization and passes this information on to the tractor. The speed of the entire assembly is automatically adjusted according to the implement's current rate of production [1]. This is all made possible by a standard called Tractor Implement Management (TIM) developed by the Agricultural Industry Electronics Foundation (AEF).

High-performance fieldbus essential

The TIM standard currently defines ISOBUS as the communication infrastructure for exchanging commands between tractor and implement. This allows implements to control certain tractor functions, such as the power take-off, linkage system, driving speed, steering angle and hydraulic valves. The advantages for the farmer are clear. Intelligent equipment automatically finds the most efficient way to complete its tasks, leaving considerably less work for the driver [2].



Typical machine system architecture[3]: Various components communicate with different protocols, which requires extensive cabling. Since POWERLINK handles everything with a single protocol, cabling is simplified immensely.

Faced with ever-increasing requirements, the CAN-based ISOBUS system has reached the limits of its potential. The situation is not made any easier by the fact that a growing number of manufacturers are installing distributed electric drive technology in heavy equipment and agricultural vehicles. To alleviate the performance bottleneck, the AEF is currently working on a high-speed ISOBUS based on standard Ethernet.

The full scope of the challenge facing mobile equipment, however, extends beyond the matter of bus performance. A typical system architecture in these applications may involve up to 30 control devices, multiple operator terminals and over 100 sensors, all communicating on seven different fieldbus networks. This requires over 3,000 meters of cable, weighing in at over 100 kilograms. A reduction in cabling alone would yield huge rewards in productivity, reliability, serviceability and fuel consumption.

POWERLINK ideal as high-speed backbone

The demands that vehicles and mobile equipment place on a fieldbus are not substantially different from those of industrial machinery. The fundamentals are maximum bandwidth, real-time capability with sub-millisecond precision, multi-master architectures and free choice of topology. Then there are features like hot plugging and transmission of safety-relevant signals up to SIL 3 / PL e.

Where mobile applications differ are the heightened requirements for harsh operating conditions, such as extended temperature range, moisture resistance and ESD protection. That's why support for the BroadR-Reach standard is also essential. With its single twisted pair construction, it plays a decisive role in the reduction of cabling weight. Each and every one of these requirements is met by POWERLINK, making it the ideal solution for mobile automation[4].

Load car demonstrates POWERLINK's potential

With its newly designed load car for tractor testing, Bavaria-based development service provider enders has demonstrated what a mobile automation solution featuring POWERLINK might look like. 'Tangible development results' is the enders promise – referring to the fully functional prototypes the company develops and builds from the ground up to customer specifications. "Our many years of working with leading manufacturers of agricultural equipment and commercial vehicles has earned us valuable expertise in this field," says Thomas Rogalski, who heads the company's embedded systems business unit.

For a tractor manufacturer, enders recently developed a new generation of load cars, which are used to simulate complex load scenarios during testing. While the previous generation was restricted to manual adjustment of fixed load settings, the new load car offers seamless and automated load adjustment to simulate the behavior of towed implements in real time. This is made possible by a 500 kilowatt eddy current brake, which is mounted along with a complete infrastructure on a self-contained towed vehicle. The data generated during testing can be used to optimize all aspects of tractor performance.

User interface with full access to all systems

"When selecting the fieldbus, one of our main concerns was to ensure that the technician in the cab has access to all of the relevant measurement and control parameters provided by the load car," explains Rogalski. Other considerations included the direct integration of safety-relevant data, such as the E-stop signal, as well as the flexibility to position additional sensors wherever they are needed.

POWERLINK will also make it easy to integrate the backup camera enders plans to add. The camera's data packets, which are sent in the protocol's asynchronous phase,

Gunnar Gubisch from B&R (2nd row from left) with the enders team. Not even the rainy weather could dampen the team's spirits upon seeing the load car in action.

can be displayed as a video stream on the same display using mapp Technology. There is no need for an extra display or extra cabling. As this example clearly demonstrates, a single high-performance fieldbus like POWERLINK can drastically reduce the number of devices and amount of cabling required in mobile applications. ←

Thomas Rogalski
enders

"What brought us to POWERLINK is its openness and its ability to integrate both safety-relevant and asynchronous data."

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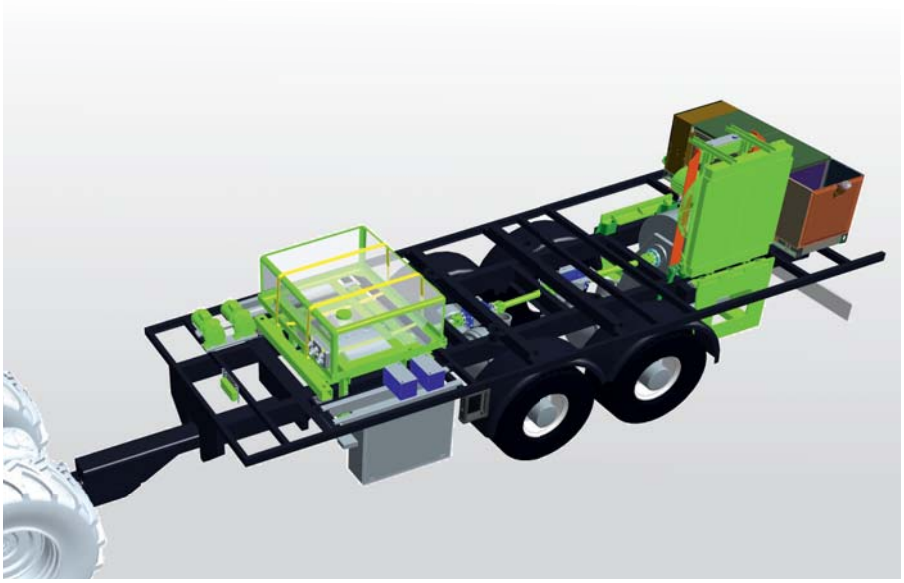
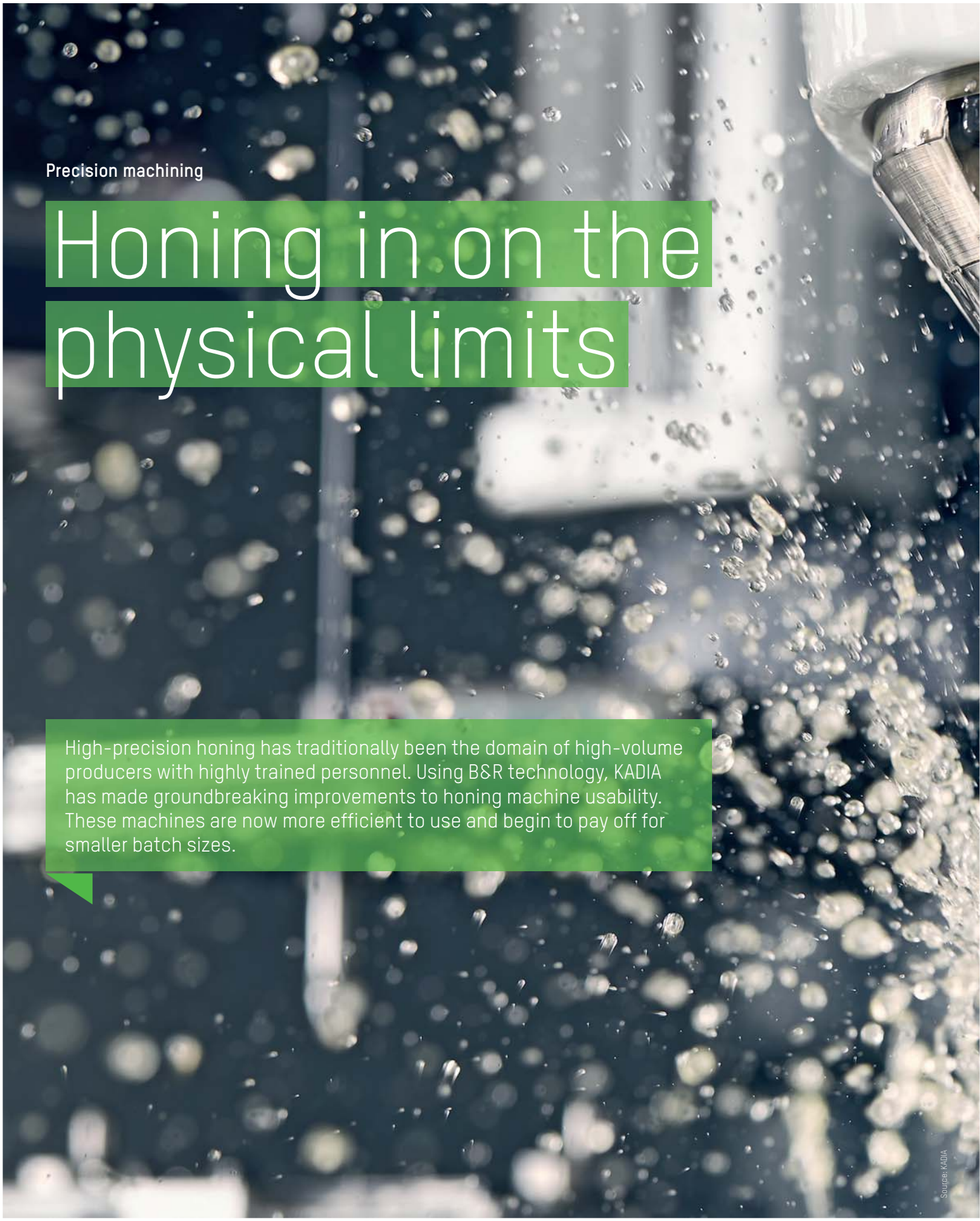


For communication with the load car, enders relies on POWERLINK. (Source: enders)

Precision machining

Honing in on the physical limits

High-precision honing has traditionally been the domain of high-volume producers with highly trained personnel. Using B&R technology, KADIA has made groundbreaking improvements to honing machine usability. These machines are now more efficient to use and begin to pay off for smaller batch sizes.



Source: KADIA

The rise of direct fuel injection is good news for Formula 1 drivers and fans – and great news for KADIA. The company's highly specialized honing equipment is what gives the cylinder bores in the interior of the fuel injection system the final polish, helping the pistons and cylinders meet the extreme levels of surface quality and trueness to shape needed to achieve operating pressures of up to 500 bar.

"We're talking about sub-micrometer precision – approaching the limits of what is physically possible to do with mechanical machining," notes KADIA's managing director, Henning Klein. "Many manufacturers require a defined clearance between the piston and the inside wall of the cylinder – for example 10 micrometers with a tolerance of less than 1 micrometer." To meet such tight tolerances requires the use of statistical measures of process capability and ultimately demands precision to within only a few hundred nanometers.

The ultimate challenge: match honing

The key to getting parts to fit together as perfectly as needed for fuel injection pumps is a machining process called match honing. This process involves measuring the outer diameter of the finished

Honed fuel injection pumps significantly reduce fuel consumption and CO_2 emissions.

Roland Regler
Chief Designer, KADIA

"The SPT functions and POWERLINK cross-communication have been key to the performance of the new HMC100 controller. These mechanisms allow the B&R drives to handle control functions remotely and to communicate directly with one another without going through the controller." (Source: F. Rossmann)

piston and passing it on to the honing controller along with the workpiece identification data. The honing controller then calculates the final dimensions of the bore to be honed, taking the desired clearance into account. Then the housing bore passes through up to six honing stations, each preceded by in-process gaging, until the final dimensions are achieved. Finally, the workpiece is clearly marked and permanently assigned to the corresponding piston.

Previous solutions with severe restrictions

Until recently, KADIA had been operating its ultra-precise machines with a controller tailored to standard machine tool requirements. "There are some significant differences compared to traditional machining processes like milling and turning, such as the number of spindles and the volumes of data being exchanged between the honing and measurement stations," notes Klein. "We had to make extensive modifications to the controller before we could use it in our honing machines." KADIA faced similar difficulties adapting the HMI application that came with the controller. "Despite our best efforts, the limitations of the HMI system left us with an unintuitive user interface that took operators some time to get used to," says Klein.

Intuitive operation for an efficient workflow

The switch to a new automation partner and the complete redesign of the control and HMI solutions have brought substantial improvements. "Based on B&R technology, the terminal's new smartphone-inspired user interface is especially intuitive to operate," says Klein. The juries of the Red Dot and IF Design awards agreed, honoring KADIA with multiple distinctions. Under the terminal's custom-tailored aluminum housing there is an industry-grade HMI device with a scratch-resistant, oil-resistant 19" touch screen. It communicates with the B&R Automation PC 910 that serves as the platform for both machine control and the HMI application.

POWERLINK cross-communication frees up resources

With its Intel Core i5 processor, the Automation PC 910 has plenty of capacity to handle the huge volumes of data generated by the constant measurement and readjustment of the honing process. "The B&R solution offers numerous technical details that really work to the advantage of the new HMC100 controller," says KADIA's chief designer, Roland Regler. "POWERLINK cross-communication has been key. It allows B&R drives to handle control functions remotely and to communicate directly with one another without going through the controller."

Source: KADIA

Winner of multiple design awards: the new R-series rotary honing machine from KADIA features cutting-edge control technology and a swing arm mounted control panel from B&R.

Inspired by smartphone design, the elegant styling and ergonomic handling of the HMC100 operator terminal make controlling KADIA's new honing machines exceptionally easy and intuitive.

Depending on the configuration a given machine, the R-series is equipped with a POWERLINK network of up to 28 liquid-cooled ACOPOSmulti servo drives. As many as five of them control the stroke movement of the LH2 / LH3 honing tools KADIA developed along with the new control system. Equipped with B&R's safe motion control solution, the drives ensure that operators are safeguarded during setup. Operating on a common DC bus, the drives are able to share excess kinetic energy that would otherwise go unused, offering clear benefits for the machines' thermal economy, energy consumption and operating costs.

Mastering machine options in Automation Studio

To future-proof its HMC100 solution and allow new systems to be added down the road, KADIA designed it to accommodate up to 40 axes. Since the number and type of honing and measurement stations also varies from machine to machine, the KADIA team has a whole spectrum of variants that it needs to cover with the control software.

"This is where another highlight of the B&R solution comes into play. Their integrated development environment, Automation Studio, allows you to create custom-tailored control and HMI applications using configuration files," explains the chief designer. "This way, we're able to represent countless potential machine configurations in a single software project with no extra programming." Later on, there's no need for commissioning technicians to use a software development tool or do any programming on site. KADIA's efforts to future-proof the HMC100 are additionally supported by the CNC and robotics functions provided in Automation Studio.

Full support from B&R

KADIA will only be able to enjoy all the potential that it has designed into the HMC100 for as long as it has access to the corresponding hardware. "That's why, beyond all the technical requirements, long-term availability was one of the key criteria in our selection of an automation partner," reports Klein. "B&R met this requirement and gave us full support throughout the entire project."

The collaborative efforts have certainly paid off. All the leading producers of fuel injector pumps have since been convinced of the advantages of the new controller, and the HMC100 has established itself as KADIA's most popular control solution. Concludes Regler enthusiastically: "What we've achieved here is absolutely revolutionary in the field of honing equipment." ←

Henning Klein
Managing Director, KADIA

"Beyond all the technical requirements, long-term availability was one of the key criteria in our selection of an automation partner. B&R met this requirement and gave us full support throughout the entire project."

Dynamic weighing

The chicken or the egg

While many eggs are destined to be fried, scrambled or poached, those that meet the weight requirements are selected to be incubated and hatched. Prinzen, the Dutch egg-handling specialist, has developed a machine able to weigh an impressive 30,000 eggs per hour. The controller that runs it comes from B&R.

Prinzen's Ovograder weighs 30,000 eggs per hour – twice the speed of its predecessor, the Elgra 3. The primary market for Prinzen's Ovograder is the broiler industry. The machine performs fast, linear grading of fresh-laid hatching eggs, and has been on the market for nearly two years now. "Equipment for processing hatching eggs is one of our strengths," says Willy Groot Zevert, product manager at Prinzen. "These are eggs that will be incubated, hatched and the chicks raised for consumption. We pack the eggs in trays or brood frames for convenient transport to the hatchery."

A good egg

Only eggs weighing in between 50 and 70 grams are acceptable for hatching. Chicks from lighter or heavier eggs don't meet the standards of poultry farmers, whose feed calculations depend on them having a relatively uniform weight. Eggs that don't meet these criteria will go on to be sold for consumption or processed into animal feed.

Although the Ovograder was developed for hatching eggs, the system can also handle eggs bound for consumption. This segment deals in larger volumes, yet Prinzen believes it is able to cover a significant portion of it. The Ovograder has three outfeed channels for hatching eggs. "OK", "Too small" and "Too big". Consumption eggs, however, are graded into four different weight classes: S, M, L and XL.

"In reality, all the eggs produced by a given poultry farm are very close in size," explains Zevert. "The vast majority of them fall in the M and L categories, so each of these gets its own outfeed. Sizes S and XL can land together in the third tray," says Groot Zevert. Since sizes S and XL come in such small quantities – typically no more than 5 to 8% – most users choose to sort these by hand.

The electronic testing egg

The Ovograder is one part of a highly automated system that begins directly at the nests, where the freshly laid eggs immediately roll out onto the first conveyor. Carried by a network of conveyors, the eggs converge at the packaging line at the front of the stall. Before they reach the Ovograder, they pass through the inspection table, where an employee sorts out cracked or irregularly shaped eggs. "We're currently

The dynamic weighing process makes Prinzen's Ovograder twice as fast as its predecessor. Prinzen achieved this performance leap using automation solutions from B&R.

working on an automation solution for this step," reveals Zevert.

A row of vertical wedges arranges the eggs into six columns on the conveyor, sliding carefully forward and backward to create space and prevent bottlenecks.

"An egg is strongest at its ends," notes Groot Zevert. "We use this property to our advantage by ensuring that any jolts the egg does have to endure are absorbed by its ends." On the whole, of course, the goal is make each egg's journey through the machine as smooth as possible. "Each step in the process bears the risk of cracking the shell," says Prinzen software engineer Gerben Kuenen. That's why the company uses soft materials wherever possible. "We also first test every system with an electronic egg. The test egg is packed with electronics to measure the g-forces. This way we find out exactly where fine tuning is needed."

Precise measurements with B&R software filters

The eggs are carried in six columns on a roller conveyor. The rolling motion naturally aligns the eggs side-ways for more efficient handling. Next, a guide bar sends six eggs at a time down a slight incline, where they experience a brief moment of free – yet guided – rolling. This offers the perfect opportunity to weigh them.

The previous-generation Elgra 3 weighed each egg statically. With the goal of increasing output to an impressive 30,000 eggs per hour, Prinzen realized static weighing would no longer be an option. Instead, they developed a concept that allows the eggs to be weighed dynamically as they roll. Each egg rolls freely across a scale that is connected to a load cell.

"We take measurements every few milliseconds," explains Kuenen. "With all the jostling that goes on at these speeds, we need multiple samples to get a reliable measurement. We do this using B&R software filters, complemented by a few that we've developed ourselves. The results are accurate to the tenth of a gram, although the specifications allow a tolerance of half a gram."

"For a businesses dealing in very large quantities, this level of precision is a very big deal," says Kuenen. Prinzen even goes so far as to re-zero the scales between measurements. This quickly compensates for any debris or egg mass that might accumulate on the scale.

POWERLINK and remote diagnostics from B&R

When it comes to controlling the Ovograder, Prinzen relies on B&R, who also provided the control solution that served them so well on the Elgra 3. "When we introduced the Elgra 3 in 2006, we were the first on the market able to perform linear electronic measurement. From a control perspective, that was significant in a number of ways. Our partner at the time wasn't able to offer us the solution we had envisioned. What we needed was a partner able to give us a PLC with integrated load cell cards – and not only that, but six of them, side by side."

Prinzen also wanted to have one central operator terminal. "POWERLINK allows us to

Eggs being transported by Prinzen's Ovoset Pro, which also features B&R technology.

The Ovograder's controller comes from B&R.

The Ovograder weighs 30,000 eggs per hour – twice the speed of its predecessor, the Elgra 3.

connect all our systems linearly and run them from a single screen – it really works great," says Kuenen. "No other supplier was able to offer us this combination. Of the numerous programming languages B&R offers, we chose to use Structured Text and found it very easy to work with. The remote diagnostics are a great help, because the level of training varies greatly between operators around the world. B&R's solution ensures they get the help they need quickly and reliably."

"Prinzen was looking for an automation partner to participate actively in the solution. B&R also had the hard-ware Prinzen needed to integrate the load cells. We were able to process all the samples in a single automation object. This data if then fed into the calculations of the B&R controller. When you begin a project like this, you also look at all the other components in the machine that are going to be automated. We don't see the sense in getting more suppliers involved than necessary," says Wico Reineman, sales representative for B&R. That's why B&R also provides the Power Panel 65. "It's a controller and an HMI system all in one," says Reineman. The Power Panel 65 also generates helpful management-level information, which can be accessed easily via USB or viewed in a web browser.

Prinzen has especially demanding requirements for speed and precision. "For the Ovograder, we had to adapt the hardware to get where they wanted to be," says Reineman. "The egg industry works in mysterious ways. Prinzen uses a load cell able to weigh up to three kilograms. This cell is used to measure quickly-rolling eggs with an average weight of 64 grams – to the tenth of a gram. This is a level of speed and precision you don't encounter very often."

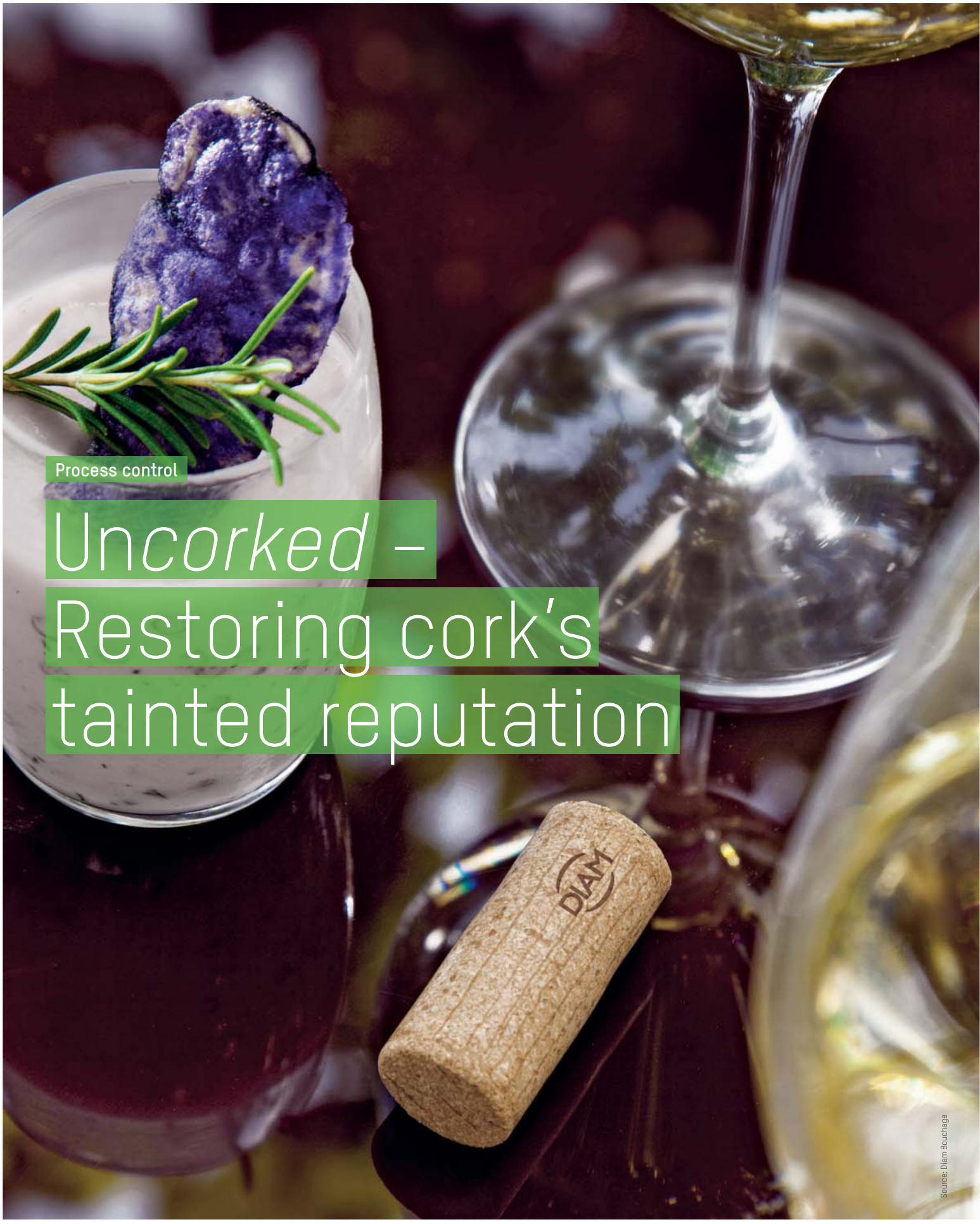
Prinzen expects to see several hundred Ovograder installations in the coming years. Reineman and Kuenen are convinced, that the next big step – up to 40,000 eggs per hour – could yet be achieved with the current hardware setup. ←

Gerben Kuenen
Software Engineer, Prinzen

"POWERLINK allows us to connect all our systems linearly and run them from a single screen – it really works great. No other supplier was able to offer us this combination. The remote diagnostics are a great help, because the level of training varies greatly between operators around the world. B&R's solution ensures they get the help they need quickly and reliably."

Process control

Uncorked – Restoring cork's tainted reputation



Source: Diam Bouchage

Despite its long tradition, romantic flair and functional advantages, the cork stopper's reputation has been marred by one unpleasant side effect. In a small percentage of bottles, the phenomenon known as cork taint leaves some wine drinkers with a bad taste in their mouth – and has led to increased use of synthetic closures and screw caps.
To restore cork to its rightful place among stoppers, Diam Bouchage has developed the first ever cork purification process based on supercritical fluid extraction – featuring B&R automation from field-level to supervisory control as well as integrated safety.

Wet dog, moldy cardboard, grandma's cellar – the telltale aromas of cork taint alter the taste of wine and render it unenjoyable. As one of the most common faults afflicting bottled wine, the risk of cork taint has played a role in the increased reliance on alternative closures. However, aside from the emotional reactions of wine lovers appalled to find their favorite wine now has a screw cap, the alternatives may also be prone to other types of aroma taint, as well as being functionally unsuited for wines with long-term aging needs.

State-of-the-art technology for authentic wine taste

To retain the functional and aesthetic advantages of cork without the risk of unpleasant side effects, Diam Bouchage, leading French manufacturer of cork stoppers, found a way to extract trichloroanisole (TCA), the primary source of cork taint, along with 150 other undesirable aromatic molecules. The answer is Diamant, a revolutionary process based on supercritical fluid extraction (SFE) using carbon dioxide. Supercritical carbon dioxide is also used to decaffeinate coffee and to extract fragrances or essential oils, yet the Diamant process represents the first ever application of SFE to cork purification.

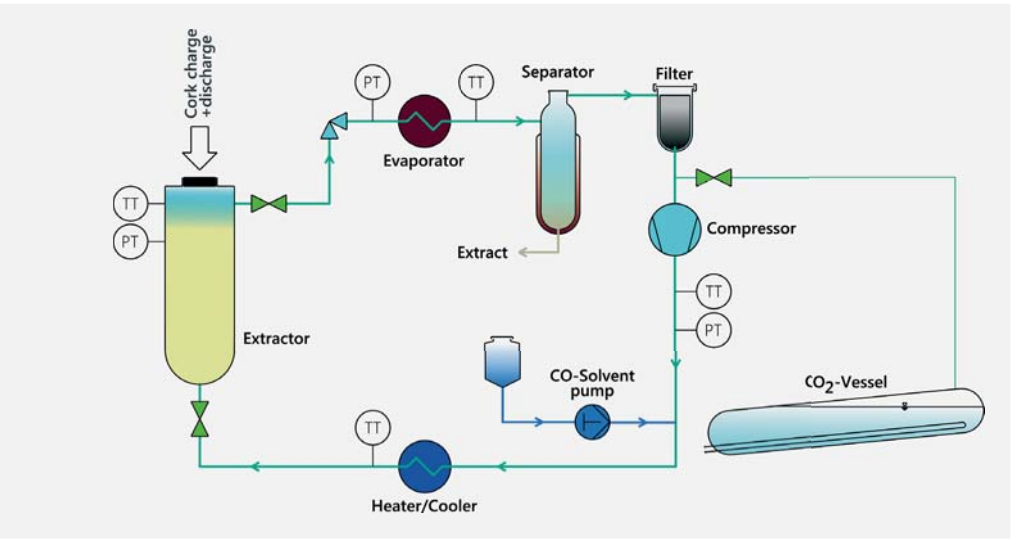
The success of this innovation has led Diam Bouchage to dramatically expand production, adding a new cork purification plant at its Céret headquarters to the two already existing in Spain. Using the Diamant process, this plant purifies an additional 3,600 tons of cork granules, upping Diam Bouchage's overall capacity to two billion stoppers per year, or about 10% of worldwide cork closure production. A crucial aspect of developing the purification plant was to ensure that it integrates perfectly with subsequent steps performed at the site – from molding and shaping to marking, coating and finishing. For its solution, Diam Bouchage called on longtime partner Natex, an Austrian system integrator and plant builder specializing in SFE process implementation.

Flexible plant automation with APROL

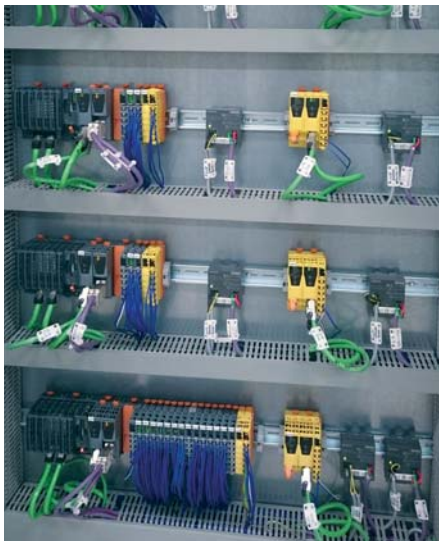
From the APROL process control software to the X20 field-level control systems, Natex automated the entire plant with B&R

Harald Huber
Electrical Engineering, Instrumentation and Controls, Natex

"We always had close contact with B&R's development and support teams. In addition to that, we had quick and direct access to B&R for spare parts supply, which is a major advantage compared to other suppliers."



Supercritical fluid extraction requires accurate monitoring and control of process data from the system's 50 control valves and 300 analog sensors. The Natex solution features four X20 controllers and 450 X20 I/O modules distributed across 32 POWERLINK network nodes. (Source: Diam Bouchage)



Four X20 PLCs control 32 POWERLINK nodes in a ring topology, while X20 safe PLCs execute SIL2-compliant safety functions. (Source: B&R)

technology. As a highly specialized company, Natex needed a flexible automation solution allowing fast process implementation for its customer. "Having equipped two smaller pilot plants with APROL in the past, we knew B&R systems would meet our flexibility and reliability needs for this large-scale project," explains Harald Huber, a Natex executive technician responsible for electrical engineering, instrumentation and control systems.

The APROL system implemented by Natex covers the whole SFE plant, comprising around 2,500 I/O points. It consists of three main operating stations with quad screening, one engineering station and two redundant runtime servers. Additionally, up to five remote operating stations can be connected via Diam Bouchage's local network. "Feedback from our plant operators has been very positive regarding user friendliness," reports Huber. "They especially appreciate all the process analysis and logging features APROL provides, like TrendViewer, AuditTrail and ShiftLog, just to name a few."

Supercritical CO_2 under control with 450 X20 modules

When a liquid is heated above its critical temperature and compressed above its critical pressure, it enters a supercritical state with unique, and very useful, properties. In this state – neither entirely gaseous nor entirely liquid – it is able to dissolve and selectively extract unwanted material. As the supercritical fluid for the Diamant process, carbon dioxide – a chemically inert and non-toxic gas, as well as a green solvent that leaves no residue – proved to be ideal.

As a high pressure batch process, Diamant purification requires accurate monitoring and control of process variables such as pressure, temperature and flow rate at various sections of the plant. The plant includes a total of 50 control valves and roughly 300 analog sensors. To collect the process data, Natex integrated four X20 controllers, one for each line, and 450 X20 I/O modules distributed across 32 POWERLINK network nodes.

Nearly all sensor signals are processed by X20 HART input modules. Temperature signals have their own X20 PT100 temperature module. Coupled with X20 HART output modules, control valves with electro-pneumatic positioners precisely control the working pressure, adding or removing carbon dioxide from the purification cycle as needed. HART data is transferred to the X20 controller via the real-time POWERLINK network and forwarded to the APROL operating stations.

Despite the complexity of the application, project implementation was pleasantly uncomplicated. "We always had close con-

Eleven operator terminals from B&R are positioned throughout the cork purification plant implemented by Natex – Diam Bouchage's system integration partner and specialist in supercritical fluid extraction processes. (Source: Diam Bouchage)

Besides offering distributed supervisory capabilities, the B&R operator terminals allow plant operators to perform a range of important tasks, from opening and closing the high-pressure quick-acting closures to starting the subsystem that empties or fills each extractor with cork. (Source: Diam Bouchage)

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Centralized and distributed – Control where it's needed

The DTM server in the X20 controller provides easy and full access to all HART field devices used in the plant, enabling better diagnostics and easy configuration. This permits high positioning precision in highly dynamic servo applications. In addition to the equipment controlled via POWERLINK, the APROL system also integrates the variable-speed drives used for the pumps and compressors, which are based on PROFIBUS DP.

For local operation and maintenance work, eleven of B&R's Power Panel T30 operator terminals are positioned around the plant. Besides offering distributed supervisory capabilities, they allow plant operators to perform a range of important tasks, such as opening and closing the high-pressure quick-acting closures or starting the subsystem that empties or fills each extractor with cork. They also assist the maintenance team in testing the compressors following service.

Fail-safe control for a high-pressure process

The Diamant process needs to be continuously operational for long periods of time. To satisfy the very high availability requirements, Natex took advantage of the many redundancy options offered by B&R systems. In addition to the redundant APROL runtime servers and redundant Ethernet-based process bus, the SFE plant builder was also able to implement a redundant control network using a POWERLINK bus in a ring topology. This solution not only maximizes the operational reliability of the plant, but also allows hot plugging in the control cabinet, which makes maintenance more efficient.

Because of the high pressures involved in the process, and in response to a HAZOP risk analysis, Natex made certain components compliant with SIL 2 – including the high-pressure quick-acting closures on the extractors. Among other measures, they ensured the extractor is pressureless and isolated from the rest of the plant before opening.

Natex implemented these and other safety functions using safe PLCs and safe I/O modules from B&R's X20 series, giving them the added advantages of integrated safety, such as reduced wiring and easier maintenance. They also relied on X20 NAMUR input modules and the X20 safe PLCs to connect the proximity switches needed for safety relevant valves. ←