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mapp technology – a revolution in software engineering

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B&R Strasse 1, 5142 Eggelsberg, Austria
t +43 7748 6586-0
automation@br-automation.com

Managing Director: Hans Wimmer

Editor: Alexandra Fabitsch
Editorial staff: Craig Potter
Authors in this issue: Eugen Albisser,
Alexandra Fabitsch, Peter Gucher, Stefan Hensel,
Peter Kemptner, Franz Joachim Rossmann,
Raimund Ruf, Thomas Schmertusch,
Huazhen Song, Miodrag Veselic

Graphic design, layout & typesetting:
Sonja Altenbuchner
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Software is playing an increasingly decisive role in the development of modern machines and systems. B&R has focused its full innovative energy on addressing this issue and will be unveiling the impressive result – mapp technology – at this year's SPC IPC Drives. Using mapp function blocks, you can develop machine software that is more robust and cheaper to maintain – and you can do it in a third of the time.

As manufacturers strive to implement the requirements of Industry 4.0 production, the share of development expenses dedicated to software will only increase. In essence, what concepts like Industry 4.0 and smart manufacturing call for is an entirely new level of production flexibility. Many see the only path to this lofty goal leading through the industrial cloud, where the traditional automation pyramid and its hierarchal – often proprietary – interfaces dissolve. This raises new challenges in terms of data and communication security. The goal is an uninterrupted web of software, data and communication that ensures full scalability from the controller up to the supervisory level.

Raw materials and components that already carry the DNA of the finished product in the earliest phases of production. Increased output despite completely individualized products. Limitless transparency throughout the production process. These are just a few examples of what Industry 4.0 will look like in practice.

There's no denying the fact that these developments will make industrial solutions – like PCs and smartphones before them – increasingly software-intensive. And this is occurring at a time when demographic developments are making it harder than ever to recruit qualified personnel in the field of software engineering.

That's why B&R has invested in the development of a new, more efficient approach to developing application software – mapp – which it will be presenting for the first time at the 2014 SPS IPC Drives exhibition. Be sure to stop by Hall 7, Booth 206 and 110 to find out how you, too, can profit from mapp. We look forward to seeing you!

Happy reading!

Peter Gucher
General Manager

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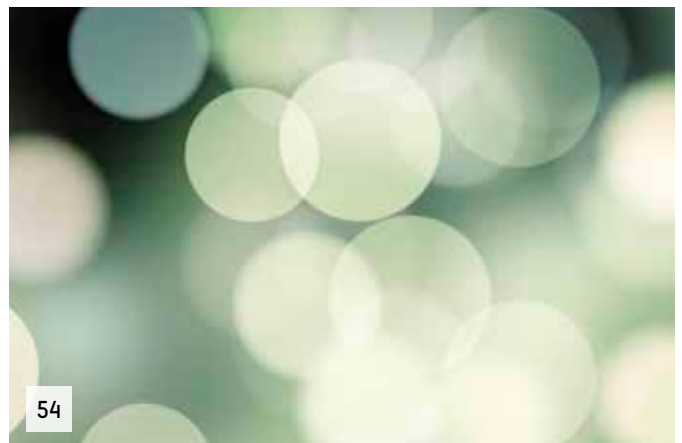
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Software engineering

A revolution in automation software



Each new machine or plant is expected to be more flexible and more efficient than the one that came before it. When it comes to achieving these ambitious development goals on time and on budget, software engineering plays an increasingly decisive role. This is where mapp – modular application technology – from B&R comes in. Using mapp function blocks, this revolutionary technology reduces development times by an average of 67%.



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Christoph Trappl
International Applications Manager, B&R

"With mapp, it is possible to accelerate development of new machines and systems by an average of 67%."



"Over the last few decades, the proportion of software development involved in new machinery and systems has skyrocketed from 5 to over 50 percent," explains Christoph Trappl, manager of International Applications at B&R – and it shows no sign of slowing. Trappl sees several reasons for this trend: "First and foremost, the production processes themselves are becoming more and more complex – especially in light of the increasing mass customization of products," he says. Purely mechanical solutions make it hard for machine builders to keep up with these new demands. At the same time, they want to protect their valuable expertise. "The mechanics of a particular solution can more easily be analyzed and reverse engineered, but this is virtually impossible for the software component," says Trappl.

Qualified software developers few and far between

The increasing demands on software mean that more and more highly qualified software designers are needed. "This is a problem for many companies," explains Trappl, "since finding these kinds of developers is difficult and expensive." In his estimation, future demographic developments will further exacerbate this problem.

Cars may have once enjoyed their role as the sole products individualized for each customer, but this time is long past. The oft-quoted "batch size one" is becoming increasingly important even outside the consumer market. The trend towards mass customization means that, when it comes to development, the role of

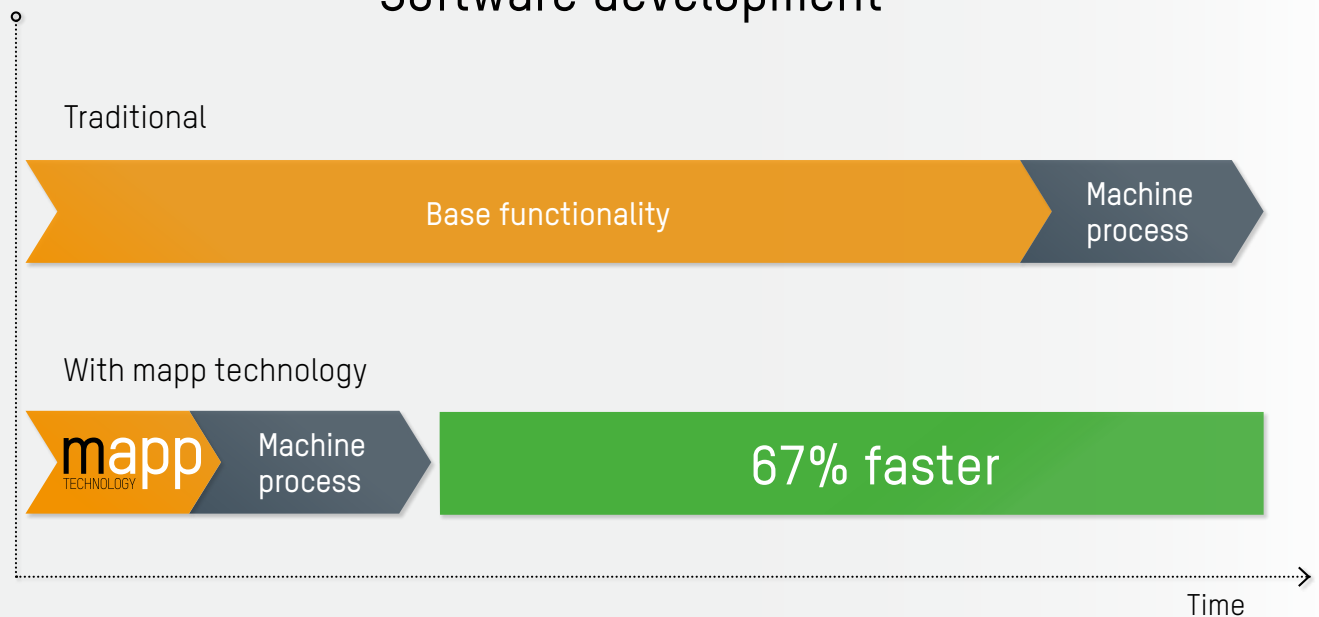
software will only continue to grow. As this happens, Industry 4.0 will turn from vision to reality. Manufacturing individual products under mass production conditions will require intricate software solutions.

And even though the software required for these types of projects will continue to become more complex, more extensive and more individualized than ever before, there will nevertheless still be those functions that will always recur. This not only includes tasks like controlling single- or multi-axis systems and general administrative features such as recipe management, but also control functions, recipe algorithms and much more. Just ensuring the base functionality of the software requires a considerable investment in both time and money.

The advantages

- 67% faster development time
- Reduced investment risk
- Increased machine availability
- Lower maintenance costs

Software development



With mapp technology, machine and system manufacturers can concentrate on developing crucial machine functions. Basic functions do not have to be programmed because simple configuration is all that is necessary.

Development time reduced by 67%

Reducing this investment is exactly what Trappl and his team had in mind when developing the modular mapp concept. Thousands of field-proven B&R applications from around the world provided the necessary benchmarks. "Our goal was to put a toolkit into the hands of development engineers that would allow them to design their own high-end software solutions without any additional special knowledge," explains Trappl. "And that's exactly what we've done with mapp."

What sets mapp function blocks apart is that they are extremely easy to configure and relieve the developer of having to program every single detail. They make it possible to implement multi-axis systems coupled via cam profiles or electronic gears, various robot kinematics, closed loop control blocks or recipe management functions – and much more – in a matter of just a couple hours.

Also included is a web-based tool for monitoring and configuring mapp functions. With mapp, it has proven possible to reduce development times by an average of 67%.

Drastically reduced project risk

mapp is fully integrated in Automation Studio. After completing a short basic training course, any developer will be able to employ mapp functions with ease. What this means for small companies is that they too will be able to implement complex software

solutions without having to worry about garnering the necessary resources themselves or risking development gone wrong.

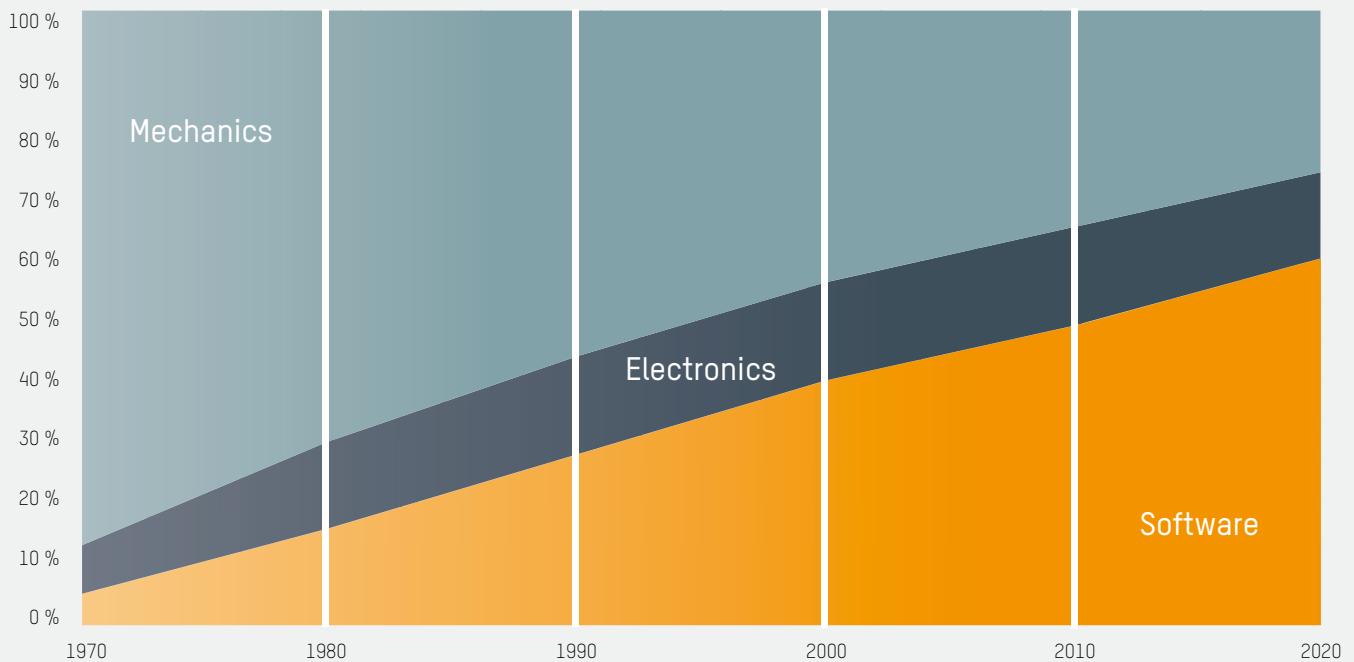
"The investment risks are drastically reduced with mapp," says Trappl. mapp function blocks have been developed from the experience gained by B&R in implementing hundreds of thousands of automation solutions all around the world, making them extremely reliable. With mapp, machine downtime due to programming errors is a thing of the past.

Increasing efficiency by focusing on core competencies

"The customer shouldn't have to worry about basic functions or software maintenance," says Trappl. "He should be concentrating instead on his core competencies as his process know-how is quickly turned into software. The most important thing for him is innovation; it's our job to supply the basic functionalities." The gateway hurdles usually involved in implementing complex software are reduced to a minimum with mapp technology.

A further contribution to increased efficiency comes from reduced maintenance costs, thanks to thorough field-testing and ongoing maintenance of the mapp function blocks by B&R. Full documentation and help functions complete the mapp toolkit. And when in doubt, you can always count on B&R's expert support team.

Shift of the development disciplines



Over the last few decades, the proportion of software development involved when designing new machinery and systems has skyrocketed.

Safeguarding engineering know-how

"A dilemma that many companies face is that the bulk of the engineering know-how is held by only one or two developers," says Trappl. If one or even both leave the company, not only do current projects suffer, but it also becomes impossible to maintain and update applications that are already in action. "This can't happen with mapp," assures Trappl. "The functions themselves are very transparent and extensively documented."

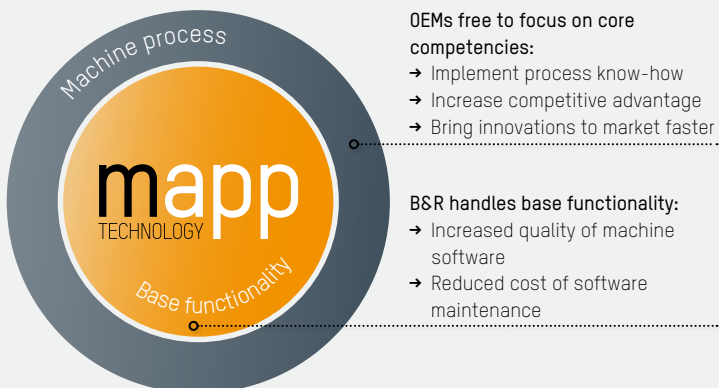
Unlimited scalability

mapp is perfect for low-end and high-end machines alike. Either way, the complete modularity and scalability of the BSR product portfolio means that mapp function blocks do not even have to be reconfigured. Once a machine has been developed, it is simply a question of replacing the HMI devices, controllers and drives to adapt to the demands of a particular market.

With mapp, BSR has developed a revolutionary new package for the development of automation software that makes it possible to accelerate projects by an average of 67%, while at the same time substantially reducing investment risk. At the introduction of mapp in November 2014, more than 70 blocks will be available. "Beginning today, it is possible to design software solutions for many extremely complex functions with less effort than ever before," says Trappl. "We're not about to rest, though."

As we speak, our team of developers and maintenance specialists all around the world continue to expand our portfolio of mapp blocks to meet the demands of the future." The latest mapp function blocks can be downloaded conveniently from the BSR website as they become available.

Your local BSR representatives will be happy to organize a mapp presentation for your company. ←



High power packed in a compact housing

Automation PC 2100: Controller and PC in one



The Automation PC is barely larger than your hand yet still delivers maximum performance right where it's needed.



The new Automation PC 2100 from B&R unites the PC world with hard real-time applications. If needed, Automation Runtime and Windows can run at the same time thanks to powerful Intel Atom multi-core processing technology, allowing the Automation PC 2100 to be used simultaneously as a high-performance industrial controller as well as a PC for things like sophisticated HMI applications. And with such compact dimensions, it takes up hardly any space at all in the control cabinet.

Despite its ultracompact housing, the Automation PC 2100 is a full-fledged PC system that represents a milestone in the performance capabilities of embedded systems – with a price/performance ratio that can't be beat. Available with single-, dual- or quad-core processors, the computing power of the Automation PC 2100 is fully scalable. At the upper range of performance, it even exceeds the performance of many Core i-series processors.

Totally maintenance-free

Regardless of the variant, the absence of fans or other rotating components means that no maintenance whatsoever is required. Other standard features include two gigabit Ethernet interfaces as well as one USB 2.0 and one USB 3.0 interface. Fieldbus connections such as POWERLINK or CAN can be individually configured, and compact MLC-based CFast cards with 60 GB or more are available to meet every memory need.

Maximum graphics performance

The graphics engine used by Intel Atom processors is derived from Core i technology and provides powerful processing all the way up to Full HD. This is also the first time that support for DirectX 11 is provided in this segment, opening up even more possibilities for enhanced graphic capabilities in SCADA and other HMI systems. ←

Process automation

The future of inorganic salt production



Photo © iStock

The German city of Darmstadt is home to the largest production plant for inorganic salts in all of Europe. Constructed at a cost of €30 million, this plant is equipped with the APROL process control system and other control hardware developed by B&R. The advantages for plant operator **Merck**? Extremely efficient production while meeting the most stringent quality standards.



Global demand for high-quality inorganic salts has increased dramatically in recent years and shows no signs of slowing. As a result, Merck began construction on an entirely new production plant in 2010 not only to keep pace with this growth, but also to ensure continued compliance with current and future GMP (Good Manufacturing Practice) regulations.

A year later, Europe's most advanced inorganic salt production complex went on stream. Today, the plant's three highly automated production lines run non-stop to produce active ingredients and excipients for the pharmaceutical and high-level nutritional industries, process chemicals for the biopharmaceutical industry and solid matter for analytical purposes.

cGMP-compliant inorganic salt production

Not only does the new Merck production complex strictly comply with current Good Manufacturing Practice (cGMP) and regulatory requirements, it also advances the company's successful EMPROVE differentiation strategy in addition to ensuring that the production of inorganic salts remains economically viable into the future.

From chemical synthesis to filtration and crystallization to filling, every production step is controlled by a fully automatic APROL process control system that is monitored around the clock by qualified personnel.

All in all, the new plant has doubled the production capacity of its decommissioned predecessor. APROL and control technology from B&R have played an enormous role in this advancement by facilitating the transition from batch-oriented to continuous processes, which has allowed the company to greatly increase production efficiency across the entire range of products.

Fast and easy product changeovers

The new process control system must be flexible enough to respond to changing requirements at any time. This is because a typical production campaign – lasting four to eight weeks – will see the production of over 70 different active and excipient ingredients across the plant's three parallel lines. This is where the full power of APROL's integrated ParameterCenter is revealed as it easily manages and transitions between recipes without pause. Merck's engineers were also particularly impressed by the validatable APROL process control system's ability to reliably automate hybrid applications that include discrete plant components, such as the new plant's filling station.

It was this type of technology – as well as other powerful features such as integrated version management and an extensive range of trend and alarm functions – that pushed APROL to the top of the other process control systems on Merck's short list.



At Merck's state-of-the-art production plant for inorganic salts, every stage in the process – including crystallization – is controlled by the fully automated APROL process control system.

The production of inorganic salts is not Merck's first acquaintance with APROL, either. B&R's process control system is also operational at over a dozen of the company's other facilities around the world.

Taking new requirements in stride

Offering unmatched scalability, B&R's APROL system has proven itself to be highly adaptable to plants of all sizes – covering the entire spectrum of requirements while still being able to maintain a comparatively low initial investment.

With 11 operator stations, over 1,000 process control loops, 500,000 calculation points and more than 2,400 remote I/O modules, the new plant is one of Merck's largest APROL installations. The plant is operated from field terminals rather than a central control station since the operators are tasked not only with monitoring the various processes, but also

loading the raw materials and removing the finished products.

When designing the plant, engineers assigned three operator terminals each to a powerful Automation PC 810 industrial computer from B&R. Acting as servers, these systems are networked to B&R I/O modules and CP382 controllers from B&R's System 2005 series via the high-speed POWERLINK real-time bus.

Effective methods for ensuring availability

The openness of the B&R solution allows the plant to be expanded at any time with minimal effort. One example is the PROFIBUS DP interface from the System 2005 series that Merck integrated to accommodate systems from other vendors should they ever become necessary.

The APROL system can be adapted or modified to the new configuration very easily.

Another advantage is that the software for operator stations and controllers can be updated from a central location without interrupting operation – a significant benefit of the APROL DownloadManager.

Any bugs that might pop up during an update are easy to eliminate thanks to the integrated version management system (ChangeControl), which logs all engineering actions and makes it simple to revert to an earlier version. A second engineering station provides added security by creating daily backups.

Merck employees handled the engineering and programming of the entire process control system themselves. Building and retaining expertise within a company is important, especially these days. It makes it possible for service personnel to become intimately familiar with the technology right from the beginning while also offering



Europe's most advanced production complex for inorganic salts is located in Darmstadt, Germany.



Powerful Automation PC 810 industrial computers from B&R act as servers for the operator terminals in Merck's new production plant.

them a role in shaping its design. This not only speeds up troubleshooting and debugging down the road, but also increases overall acceptance of the system.

Startup accelerated by simulation

Acceptance of the B&R solution by Merck employees was also bolstered by the fact that large portions of the HMI and control software could be tested prior to the construction and commissioning of the plant. To make this possible, Merck equipped a testing room with every last bit of the B&R control hardware along with an interface to a WinMOD system that simulated the plant's I/O requirements. This not only increased programming efficiency, but also allowed a variety of different concepts to be evaluated. In addition, feedback provided by employees about both the design and layout of process graphics as well as the menu navigation system was taken into account very early in development.

Together with the ability to perform advanced testing of software components such as the sequence control, all of this trimmed valuable time off the commissioning phase and had the plant up and running at full capacity in no time. The simulation interface will continue to be useful in the future as well – for testing potential updates to the process control system.

Goals set, goals achieved

Stepping back to assess their new process control system in its entirety, Merck's engineers cannot help but come to a positive conclusion: All of their expectations have been fully satisfied. Each and every goal – from expanded capacity and improved efficiency to increased availability – has been achieved. ←

APROL

All of this with the help of the APROL process control system and technology from B&R – the perfect solution for optimizing plants of all sizes.

Interview

"Automation Studio is extremely flexible"

B&R's Automation Studio engineering software is a universal tool for every phase of an automation project – from development and commissioning to maintenance and diagnostics. Hans Egermeier, business manager for Automation Software, speaks about current challenges facing the automation industry and the new functions available in Automation Studio.





The contribution of software engineering to the development of new machines and systems is constantly increasing. What challenges face engineering platforms such as Automation Studio in relation to Industry 4.0?

The demands facing machines and systems are on the rise: improved product quality, faster production speeds and series production with a batch size of one are just a few examples. No matter what, the software has to be able to handle increasingly complex tasks. We need tools that can master this complexity. At the same time, ensuring an environment that fosters innovation is a must. New systems, machines and applications have to be developed and set up quickly. This also means that software like Automation Studio must provide the maximum possible degree of flexibility.

What functions have been implemented in Automation Studio to meet these challenges?

It's not really the individual functions that make Automation Studio an ideal engineering platform. The entire concept is much more important. That's why anyone who uses B&R technology to automate their machines only needs a single tool: Automation Studio. This one development environment handles all essential product types – from the controller and HMI systems to motion control and even safety technology, everything is fully integrated. The size of the automation solution doesn't make a difference. Whether you're working with a small machine or automating an entire plant, you can still work with the same tool. Whenever you develop a new variant of an existing machine, it's possible to reuse a large part of the software.

For machine manufacturers, engineering is only part of the job. What do things look like after development is finished?

Development is only one part of Automation Studio. This software can also be used to manage all other tasks, including commissioning, troubleshooting and service. In addition to the advanced simulation tools also integrated in Automation Studio, its modular and object-oriented approach to programming ensures that software is simple and clearly structured, regardless of the degree of complexity.

Is all of this enough to keep development going at the required rate?

No, it is also necessary to stop developing the mechanical, electronic and software components of a project separately. Automation Studio makes it possible for these three engineering disciplines to be worked on simultaneously to a very large degree, which saves quite a lot of time. Even more time is saved when the software is developed in modular units.

Isn't it much more complicated to work on multiple areas at the same time?

Yes, it's more complicated, but structured and modularized software development and clearly defined interfaces allow software to be reliably developed and tested in self-contained modules. It even allows for improved software quality. With the mechanical components, modular machine concepts have already more than proven their worth. Whereas the traditional approach has been to develop an entire machine generation in one fell swoop, it is now possible to develop upgraded versions of individual components separately. This evens out the load on the development team and relieves the pressure associated with notoriously tight completion deadlines. We are now applying this kind of modularization to software development.

Do developers need to receive extra training for parallel development?

Automation Studio is extremely flexible. We rely on widely used standards such as IEC 61131 and C/C++, which allows everyone to program in their preferred programming language and software to be easily reused and swapped out. Special training for parallel development is not needed. Automation Studio's flexibility is also evident in other areas. For example, it is easy to link defined interfaces and formats from other engineering software, such as simulation tools from MATLAB and MapleSim or E-CAD applications from EPLAN Electric P8. Additional interfaces on the controller also make it easy to establish database and Internet connections. Of course, all common fieldbus systems are also supported. OPC UA, TCP/IP and UDP can be used to connect directly to the supervisory level. And by combining the real-time Ethernet POWERLINK protocol, openSAFETY and various conventional fieldbus systems, we can offer a complete portfolio when it comes to communication.

Automation Studio is constantly being further developed. What are the latest innovations?

We have implemented many improvements that make it even easier to develop new software. This includes simplified hardware configuration using a virtual control cabinet and integrated drive sizing. We have also introduced unit testing, a feature that provides a structured test for software that goes a long way to ensuring total quality assurance. Another advancement is the implementation of OPC UA, which allows the highest level of integration directly on the controller. In addition, we have implemented a wide range of technology solutions for the printing and process industries, for example. These packages include complete solutions for typical application tasks in a certain industry, allowing for much easier and faster development. ←





Motion control

Faster, smaller, ACOPOS

More than ever before, machine and system manufacturers are being bombarded with demands for increased productivity and availability. At the same time, pressure is constantly building to reduce the manufacturing costs for production machines. The new servo drive generation from B&R was designed to meet these challenges. Offering a high degree of integration and an extremely fast sampling time of 50 μ s, the ACOPOS P3 is opening up entirely new opportunities for virtual sensors.



The ACOPOS P3 compact servo drive can control of up to 3 axes simultaneously.



Complex production processes require complex machines – and therefore sophisticated hardware and software. The control cabinets for advanced machines and systems take up additional space in production halls, while their procurement, cabling and cooling can quickly drive up costs. Machine and system manufacturers therefore do all they can to reduce control cabinet space to a minimum. Reducing the space that hardware takes up in the control cabinet, the footprint of the devices located there, is crucial.

Smaller: 69% space savings

"Compact products represent the future of automation," explains Alois Holzleitner, technical manager of motion systems at B&R. It is therefore important to reduce the number of automation components needed,

the amount of space they require and their overall complexity. "This was what we had in mind when developing the ACOPOS P3," he continues. The ACOPOS P3 can control up to three axes per device, even though the housing is no larger than a standard single-axis drive. This frees up to 69% more space in the control cabinet. And when it comes to making the best possible use of this saved space, the P3 is the front-runner for servo drives with integrated safety functions: The power density of this 3-axis drive is over 4 amps per liter.

Faster: 50 µs sampling time

For highly dynamic and precise processes like those in the printing and packaging industry, high-speed precision control of movements is a must. One of the factors that limits speed is the sampling time of

the servo drive. The cycle time for current, speed and position control on the ACOPOS P3 is 50 µs. "This sampling time allows us to implement new closed-loop control processes that can be summed up under the term 'virtual sensor technology'," explains Holzleitner. The necessary bandwidth and precision on the network is provided by POWERLINK.

The advantages

- 69% smaller footprint
- 50 µs sampling time
- Virtual sensors
- Use anywhere in the world



Alois Holzleitner, Technical Manager - Motion, B&R

"The groundbreaking ACOPOS P3 is intuitive to operate and offers better performance, more safety functions and a higher level of availability in the smallest possible space."

The trend in machine manufacturing is towards saving energy, which puts a premium on lightweight construction. Engineers attempt to reduce masses that require moving to a minimum in order to keep the amount of energy required as low as possible. This results in reduced rigidity and increased elasticity, however.

Virtual sensors make it possible to control these elastic systems without having to use additional position measurement systems at the process intervention point. The use of virtual position encoders in the motor is becoming more common, eliminating the need for a motor position encoder, cable and evaluation unit in the servo drive while increasing availability. "There are also further additions to the standard controller cascade for ACOPOS P3 servo drives,"

explains Holzleitner. This includes repetitive control, for example, which makes it possible to predict and compensate for lag errors. The result? More precise control, improved performance and increased product quality.

Safer: 14 safety functions

Thanks to machinery directives in the EU and similar legal regulations in other parts of the world, the safety functions in automation components are becoming increasingly important. The ACOPOS P3 provides many safety functions that satisfy SIL 3 / PL e, Category 4 requirements. A completely new function, Safely Limited Torque (SLT), checks whether the maximum permitted torque has been exceeded. "The combination of SLS and SLT, together with ultrafast response times, provides highly effective protection against injury," explains Holzleitner. The Remanent Safe Position (RSP) safety function is also new. This safe position data allows the safe monitoring of all serial kinematic chains for robots with regard to velocity, orientation and workspace. All 14 safety functions are completely network-based and can be used dynamically in the system thanks to openSAFETY.

Integrated safety functions

ST0, SS1, SS2, SLS, SMS, SBC, SDI, SLI, SLP, SMP, SLA, RSP, SBT and SLT

Less: 1 cable

A motor traditionally requires two cables – the motor cable and the encoder cable. Eliminating one of these cables not only results in reduced cable costs, but also

less time and effort when it comes to commissioning and maintenance. As the name suggests, a one-cable solution allows motor power, encoder data and digital safety information to be transferred between the ACOPOS P3 and motor using just a single cable, reducing both component and commissioning costs. A conventional connection using motor and encoder cables is still possible without any problems.

International: 4 power mains forms

It's not just differences in voltage levels that make it more difficult to design machines for use in different countries on different continents, entirely different power mains systems can also present a problem. "Machine and system manufacturers are often forced to use isolating transformers in order to adapt to the situation in other countries," says Holzleitner.

The flexibility of the ACOPOS P3 shines in this regard since it supports the world's most common power mains configurations, such as TN, TT, IT and corner grounded TN-S systems. In some circumstances, only an additional line filter is needed to meet the necessary regulations. In addition, the ACOPOS P3 satisfies the machine manufacturing requirements set forth in EN 61000-6-4 (generic standards for industrial emissions) and EN 61800-3 (first environment, category C2).

B&R will be presenting the ACOPOS P3 at the SPS/IPC/Drives trade fair in Nuremberg in November 2014. Versions with 1, 2 and 3 axes will be available, covering a power spectrum ranging from 0.5 to 24 kW. Over 1,000 ACOPOS P3 drives can be controlled in a single system. The ACOPOS P3 is compatible with all previous servo drives from B&R and can be connected together with them in a network. ←

Handling systems

Versatile machining with POWERLINK



The universal Chameleon handling system provides a reliable supply of workpieces, electrodes and milling tools for a wide variety of machines.

From EDM and handling systems to shop floor software – **Zimmer & Kreim** offer everything from a single source. When the company sought to expand its Chameleon handling system, the heightened safety requirements of the EU's new machinery directive presented a complex challenge. With a combination of integrated safety technology from B&R and the open, real-time POWERLINK fieldbus protocol, they found exactly the solution they were looking for.



"People laughed back in 1985 when we were the first to use an electrode changer for die sinking," recalls managing partner Klaus Kreim. The laughter stopped quickly, however. Since EDM is such a slow process compared to other machining techniques, the fully automated electrode changer offered a clear advantage: by allowing production to continue through the nighttime hours, it significantly increased output.

Shaping things up

EDM stands for electric discharge machining – a manufacturing process that uses electrical discharges, or sparks, from an electrode tool to gradually remove material from a conductive workpiece. These machines may use one of several different methods, including wire-cut EDM, small hole drilling EDM or die sinking EDM. The latter involves sinking the electrode, whose shape is the negative of the desired result, into the workpiece.

Zimmer & Kreim is a market leader when it comes to die sinking EDM machines. Chameleon, the company's fully-automated, universal handling system, supplies machines and magazines with workpieces, electrodes and milling tools – even during operation – both horizontally and vertically. True to its name, the Chameleon adapts to all different technologies, able to easily integrate a wide range of production machines such as milling or wire-cut EDM machines. It provides a seamless flow of materials throughout the entire processing chain in the tool and mold-making industry – even including the final step of cleaning and drying to prepare for the next use. The clear advantage: shorter processing times for substantially increased output.

During EDM processing, the electrodes generate sparks between the tool-electrode and the workpiece being shaped. The shape of the tool-electrode is the negative of the desired final shape of the workpiece – which could be virtually anything from a Lego block to a car dashboard to a shampoo bottle. The areas of application are virtually limitless: From toys to automotive to packaging – there is hardly an industry where EDM processing isn't involved at some step along the way. "Some of the simplest everyday commodities are made this way," Kreim points out. "Very few people stop to think about the complex technology behind it." Once an electrode-tool has been milled, the handling system takes it to the measurement machine, which measures it, determines its zero point and verifies its quality.

The goal: Faster and better than the competition

By now, the EDM process has been optimized to its mechanical limits. Any competitive advantage that remains to be gained must come from fine-tuning details such as computing performance. In the worst case scenario, a computer failure could turn the EDM process into a welding process, with material being added to the workpiece rather than eroded away. The potential damage to the workpiece surface through such an error makes it extremely important that the pulses of voltage to the electrodes are constantly monitored.

This is done using an analog-to-digital converter, which – with a sampling rate ten times faster than the pulse width – monitors one thousand measurement points every microsecond. The focus of this monitoring is on the amplitude of the voltage pulse. If there



Volkmar Marquardt, Head of Development, Zimmer & Kreim

"The decision fell quickly in B&R's favor, particularly because of how easy it would be to implement POWERLINK." "There were other bus systems that we could theoretically have integrated, but it would have been rudimentary and lacked safety functionality. That wouldn't have been any help."



From left to right: Miodrag Veselic (B&R), Jan Hendrik Heilmann (B&R), Volkmar Marquardt (Head of Development), Klaus Kreim (Managing Partner) and Michael Frank (Chief Software Developer)

is a delay in the pulse, it must be re-triggered to achieve the desired duration, which determines the quality of the workpiece surface. A voltage that is too low (below 5 volts) is equivalent to a short circuit, while voltage that is too high (over 24 volts) is referred to as open-circuit voltage. This is measured using an oscilloscope, which first takes a base reading and then monitors the surface.

Shorter voltage pulses (around 1 μ s each) produce a smoother surface, but also make processing take longer.

Developing a distributed system with B&R

"Our Chameleon handling system has been around since 2007, but back then, all the safety technology – the E-stop circuits, light curtains and other equipment – was an entirely discrete system," notes Volkmar Marquardt, head of development at Zimmer & Kreim.

"Our handling system was already scalable at the time, but only for up to two machines. The system expanded quickly after that, and has now reached 23 meters in length with 9 machines and 12 magazines. With the increasingly stringent safety requirements and the new machinery directive, we had to look at how to move

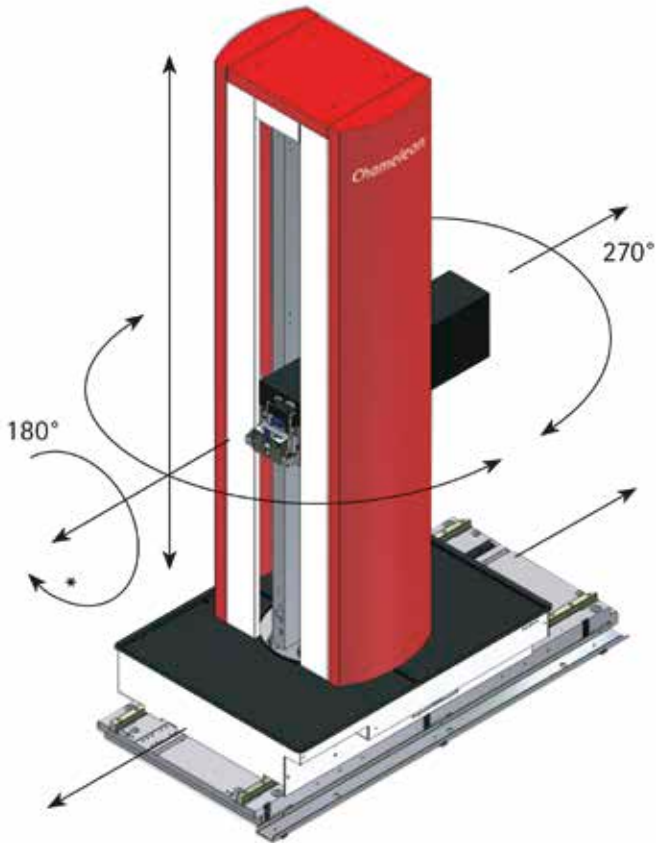
toward a distributed solution, and who would be the best partner to help us get there," Marquardt continues.

For Zimmer & Kreim, it was clear from the beginning that the distributed system would be built together with its longstanding technology partner, and now primary shareholder, Indel.

More safety – with POWERLINK and openSAFETY

With a number of suppliers in the running, it was B&R who got the green light. "The decision fell quickly in B&R's favor," says Marquardt, "particularly because of how easy it would be for Indel to implement POWERLINK, and also because the solution provided all the required safety features."

B&R's safety solution also facilitates a modular design of the overall line, where communication between all of the subsystems takes place over openSAFETY and POWERLINK. All of the hardware is configured using the Automation Studio development tool, and the safety application for the SafeLOGIC safety controller is created in the visual SafeDESIGNER editor. As an integral component of the Automation Studio engineering environment, SafeDESIGNER



The movement of the Chameleon robot: C-Rotation 270°

open SAFETY

openSAFETY is the first open and only bus-independent safety standard available for all industrial Ethernet and fieldbus solutions. This technology makes it easier to implement safety solutions in compliance with current 2006/42/EC machine guidelines as well as other applicable standards. Using the "Black Channel" principle, openSAFETY is the only safety protocol in the world that can transfer secure data via any fieldbus system. openSAFETY is a step ahead of the rest with regard to response times as well.

The additional integration of POWERLINK further reduces the response times and drastically improves the availability of machines and production lines.

ensures safety and reliability when programming sensitive functions for the protection of equipment and personnel.

All modifications to safety systems are completely protected by a restrictive change process. The basic elements of the safety application only have to be developed once, after which they can simply be selected and enabled according to the actual requirements of any given line – without having to make any other changes to the safety application itself.

Prior to POWERLINK, Zimmer & Kreim used a fiber optic bus. The electrical network was laid out in a star topology, while the fiber optic bus was a ring, which made troubleshooting a nightmare. With POWERLINK they can now mix star and ring topologies as needed and are free to make changes as requirements dictate. "There were other bus systems that we could theoretically have integrated, but it would have been rudimentary and lacked safety functionality. That wouldn't have been any help," says Marquardt.

The new solution also uses B&R's SafeLOGIC controller to handle the safety application. The various functional and safety I/Os used

can be combined flexibly to adapt optimally to the topology of the machine. Valve terminals are also directly integrated in the I/O network. This results in fewer I/O modules and less wiring, which also reduces the production cost of a machine.

Consistent quality, worldwide

Zimmer & Kreim have few competitors in their field – most of them located in Germany, Austria and Switzerland, with Japan quickly gaining ground as well.

"Time and again, we've seen German manufacturers try moving production to China in order to cut costs," says Kreim. "When precision is critical, however, the products fail to live up to the necessary quality standards and end up coming back. The problems with the technology, and ultimately with quality, are the result of an insufficiently trained workforce."

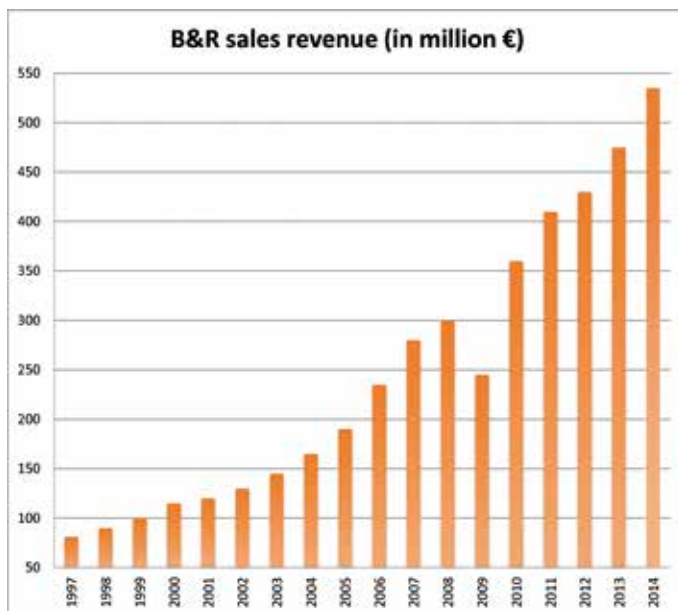
A well-known electronics manufacturer placed an order with Zimmer & Kreim, and within six months, four completely automated manufacturing systems were on their way to Asia. This was a big win for the company and its 80 employees. ←

B&R surpasses the half-billion mark

13% increase in sales:
Automation specialist continues
along the road to success

B&R increases market share

"We have considerably increased our market share," says Gucher. Whereas industrial production has only returned to pre-2008 levels in 2014, B&R sales have increased 75% during this time. B&R's core market is in Europe, where two-thirds of the company's sales are generated. The strongest increase in sales revenue was generated in Asia and North America.



In 2014, B&R achieved sales revenue over €500 million for the first time.



In the current year, B&R is expecting record sales revenue of €535 million, therefore surpassing the defined goal of a half-billion euros by a wide margin. This was announced by general manager Peter Gucher at B&R's annual press conference. With a 13% increase in sales, the company continues along the highly successful course laid out in previous years.

Innovation fosters growth

In the past 12 months, machine and system manufacturers have automated 270,000 machines with B&R controllers. "The complete scalability of our entire product range gives us a clear competitive edge on the market," explains Gucher. "With Scalability+ solutions, we already offer the tools needed for flexible production as envisioned in the Industry 4.0 concept."



Peter Gucher, General Manager, B&R

"Our innovations have helped us to considerably increase B&R's market share."

700 new engineers in 5 years

To ensure that its technologies remain on top in the automation industry, B&R invests nearly 15% of sales revenue back into research and development. "We can only continue along the road to success by developing new innovations," says Gucher. In the last five years alone, over 700 engineers have been hired. In addition, ten percent of all engineering hours is invested in training and continued education. ←

Breaking ground all around the globe

B&R opens subsidiary in Japan and new branch office Manchester



Managing Director Masashi Ono leads the new B&R subsidiary in Japan.



Leading provider of automation technology B&R is proud to announce the opening of its 24th subsidiary – B&R Japan, headquartered in Yokohama and led by Masashi Ono.

"Japan is one of the toughest markets in the world, but we're ready," says Ono. "We're confident that Japanese customers will enjoy working with us, and we look forward to showing them all the exciting things that our innovative portfolio and automation expertise can do for their business."

As one of B&R's strengths is its strong local presence, B&R Japan starts with a full team of sales, application and support engineers to care for Japanese customers at their locations and in their own language. B&R has an impressive 35-year record of continuous growth and has proven its dedication to innovation.

"With the strength of open technology and international standards as well as a network of subsidiaries and partners in over 70 countries, B&R is a solid partner for Japanese companies looking to compete with the top players on a global scale," says Ono. ←



General Manager Simon Goodwin (right) wishes the new team all the best.



In response to increasing levels of business in the North of England and Scotland, B&R is pleased to announce the opening of a new office in Manchester. Managed by area sales manager Andrew Norcliffe, the new B&R UK Northern office employs 3 application engineers, including a dedicated B&R technology trainer. Plans are already in the works to expand the team.

"The highest levels of customer and application support are integral to our business model," said Norcliffe. "This factor, along with the growth in our business, has meant that the opening of a new office in the North of England was essential."

B&R's Northern office serves customers in a wide range of fields such as renewable energy and the chemical industry, as well as in more established markets such as food and beverage, packaging and plastics. It is B&R's 3rd office in the United Kingdom, the others being headquarters in Peterborough and another office in Bristol.

B&R wishes all the best to its new ambassadors of Perfection in Automation! ←

Ultrasonic welding

Safe and ultrasound

Efficient and versatile, yet also powerful and equipped with the latest in safety technology – that's what **Telsonic** was looking for in its new control solution. Based on the X20 system and the SafeLOGIC-X safety solution from B&R, the ultrasonic welding specialist has introduced the TCS5, which skillfully unites all of these characteristics in a single solution. The openness and universal connectivity of B&R's technology ensure that the new controller has no problem sharing data with other systems.





The range of industrial applications for ultrasound is virtually limitless. Whether you need a water-tight connection between a car's taillights and the body or a clean seal on a boxed beverage – Telsonic can offer a perfect solution with its powerful ultrasonic generators and custom sonotrodes. In addition to the proven longitudinal process, the Swiss company has also patented two other unique welding methods: SONIQTWIST and PowerWheel.

Until now, the core components of the ultrasonic system were controlled using embedded hardware that was developed in-house more than 15 years ago. "Back then, we weren't able to find an alternative that lived up to our cost and performance requirements," explains Telsonic's research and innovation manager, Peter Solenthaler. At the time, there was no PLC on the market that could provide the necessary cycle time of under one millisecond.

1 ms cycle time? No problem!

Things have changed quite a bit in the past decade and a half. For B&R controllers, sub-millisecond cycle times – which are needed to precisely control high-speed ultrasonic generators and the energy they transfer into the workpiece – are no problem at all. "One highlight of B&R's solution is the ability to clearly prioritize tasks," says Solenthaler.

But that's not the only reason Telsonic decided in favor of controllers from B&R's X20 system. "The past few years have seen a drastic increase in safety requirements – particularly those that apply to our Cut'n'Seal presses – as well as require-



Integrated B&R safety technology guarantees operator safety, even in the most cost-sensitive applications.



Welding delicate plastic membranes requires a high-speed controller with sub-millisecond cycle times.

ETHERNET POWERLINK

POWERLINK is the first and only real-time Ethernet standard that offers all aspects of true open source software. It was developed to be easily portable to any hardware platform and operating system. One important aspect is that POWERLINK is available under a BSD license, which grants system developers full rights to the software and makes it the only Ethernet-based industrial communication standard that is genuinely manufacturer-independent.

ments for documentation and traceability of the welding process," says Solenthaler.

SafeLOGIC-X saves costs

These demanding requirements are solved in a remarkably economical way by combining B&R's X20 system with its software-based safety solution: SafeLOGIC-X. "What makes this solution especially cost-effective is the fact that we don't have any hardware to certify, maintain and update. B&R handles all of that," says Solenthaler.

The modular design and universal interoperability of B&R's control and I/O compo-

nents are of particular benefit for Telsonic, whose developments feature a common core around which each unique solution is custom-built to meet the needs of the user. "It's very quick to add on components such as X-Y axes or various clamps, infeeds and other systems," reports Solenthaler. "The universal development environment provided by Automation Studio also plays a key role here."

The X20 system's wide selection of bus controllers and standard interface modules also makes it easy for Telsonic to connect the new control system to higher-

level machine control and ERP systems and exchange large volumes of data.

Uniquely open and future-ready

"When it comes to networking our systems, we happily rely on POWERLINK. B&R's dedication to open source technology gives us a uniquely open and future-ready real-time Ethernet standard that makes it easy for us to keep our overall costs low," says Solenthaler.

Flexibility and future-readiness were also factors in Telsonic's decision to use an open source Debian operating system with



Telsonic's high-precision TPS300 torsional press is designed for large welding objects, delivering a welding force of 3,000 N at 6,500 W of power and a frequency of 20 kHz. The control solution is built around the X20 system from B&R.



From ultrasonic sieving, cleaning and cutting to ultrasonic welding of metal and plastic – thanks to the modular X20 system, the new Telsonic controller can be quickly and easily adapted to any of ultrasonic technology's diverse range of applications.

a VNC client for its HMI platform. The swing arm mounted operator panel communicates via Ethernet with the X20 controller running the HMI application.

The advantage of this approach is that if there is ever a problem with the screen, any PC with a VNC client installed can be connected to the controller so that work can be resumed immediately.

Economical, flexible and efficient

With the software-based SafeLOGIC-X safety controller and utilization of open source solutions, the TCS5 controller is

both economical and future-ready. B&R's commitment to modular design and support for a broad array of communication standards, together with the universal Automation Studio engineering environment allow Telsonic's new controller to

be adapted quickly and effortlessly to the unique requirements of each application and end customer. "Simply put, with B&R, both we and our end customer get something for our money," says Solenthaler. ←

Peter Solenthaler, Research & Innovation Manager, Telsonic AG

"When it comes to networking our systems, we happily rely on POWERLINK. B&R's dedication to open source technology gives us a uniquely open and future-ready real-time Ethernet standard that makes it easy for us to keep our overall costs low."



CNC

The flexible future of multi-axis machining

Christoph Stark, CEO of machine manufacturer **imes-icore**, is convinced that even today's most state-of-the-art milling machines have considerable room for increased automation. His company has taken the first step in that direction with a new control solution based on B&R automation technology. The first implementation for this new controller is a universal machine architecture, redesigned from the ground up, which imes-icore has already used successfully in numerous multi-axis machining applications.



The Platinum X3 three-axis milling machine is the first imes-icore system to be built on the universal Platinum architecture.

ETHERNET POWERLINK

The real-time Ethernet protocol POWERLINK provides optimal support for controlling high-speed axes such as the spindle drives used in milling machines. A transmission speed of 100 Mbit/s and a synchronization accuracy of +/- 100 ns make it easy to combine control logic, robotics, CNC and motion control on a single network – allowing for machines with a higher degree of automation than ever before.



When Stark speaks of increased automation, he means more than simply following the trend toward 5-axis machine tools able to create complex shapes without having to reposition the workpiece. "Particularly in applications with long milling times or large batch sizes, it is increasingly important for these machines to integrate with production lines and plant-level systems," he explains. "And it won't be long before they will be asked to take on additional functions such as measuring and engraving the workpiece."

Conventional CNC controllers, like the ones imes-icore has been using successfully in its Premium series for years, are not up to this task. After all, as Stark points out, "They lack the openness and flexibility you need to create a custom solution in an efficient and cost-effective way."

The same applies to the HMI design, which allows little if any room for customization to accommodate the wishes of machine builders and their customers.

Setting off on the ambitious course of completely reinventing its Platinum architecture, which would serve as the basis for a full ensemble of machine tools, imes-icore took the opportunity to revamp its automation solution as well.

12 weeks to a custom machine

"Our goal is to completely master every aspect of our control technology," says Stark. "That's the only way we'll be able to implement a custom solution quickly and on a reasonable budget so that we can deliver our customer a finished system within 10 to 12 weeks of receiving their order."

To achieve this, the automation needed to be just as open, flexible and manageable as the Platinum architecture itself. "B&R delivered impressively on every one of those criteria," concludes Stark. "We also appreciated B&R's ability as a partner to pick up on the latest technology trends and help us channel them into our solutions to our customers' advantage."

With B&R's support, imes-icore was able to quickly gather the expertise that allows it to tailor the control solution to each machine's unique requirements.

CNC as an automation component

The new control solution was built on the foundations of B&R's Generic Motion Control (GMC) concept and its comprehensive standard package of CNC functionality. B&R developed GMC as a solution to provide



Based on 3rd generation Core i-series processors – the benchmark for top-performing PC architectures – the Automation PC 910 offers maximum computing power for the most complex tasks.

seamless automation of machining and handling processes. This unique platform brings together motion control, sequence control, drives and safety technology, as well as HMI and an array of communication interfaces into a single integrated system.

The standard CNC package builds on this platform to provide both the hardware components and the corresponding software functions needed to operate a typical CNC machine.

Custom CNC panel

The solution includes a CNC panel featuring a 15" portrait display with a keyboard and integrated keys for machine operation, plus a handheld device with a handwheel. As an added bonus, the CNC panel design can be largely customized according to the wishes and requirements of the machine builder and their end customer. With the HMI application and preprogrammed software functions included in delivery, the development process is considerably streamlined. It is also no problem at all for the machine builder to modify or expand the CNC software as needed.

As a platform for executing the control and HMI applications, imes-icore selected a powerful industrial PC from B&R's Automation PC 910 series. At its side, a SafeLOGIC controller handles integrated safety functionality. Drives from the ACOPOSmulti series provide dynamic motor control, while a fast, real-time Ethernet POWERLINK network connects the drives – as well as the safe and standard I/O modules – to the controllers.



imes-icore is a specialist in custom machine tools used to create complex profiles and 3D structures.



One controller for all actuators

The architecture's modular design allows it to be quickly and easily adapted to various types of machines. "We really appreciate having a controller that supports all types of actuators – whether stepper, servo or linear – with only minor modifications to the software," says Stark.

For imes-icore this is a key feature. After all, the Platinum architecture is designed to allow customers to select either normal spindle drives or linear motors. The aluminum-granite sandwich construction of the moving axes combines lightweight strength with the rigidity needed for maximum precision. These axes also feature crumple zones designed to absorb the force of an impact and prevent damage to the granite – which minimizes the amount of downtime required for repairs.

imes-icore also designed the Platinum architecture to allow the work area to be adapted flexibly to customers' requirements. As a member of the ISEL Group, imes-icore also received support from its sister company, ISEL Germany, who manu-

B&R's CNC panel fuses ultimate functionality with elegant design and can easily be customized to OEM requirements.

factures automation components such as spindle drives and linear guide rails.

New controller proves itself in the field

The overwhelmingly positive reaction to the price/performance ratio of the more than 40 milling machines already in use – featuring the powerful new control solution from B&R – is no great surprise.

Yet imes-icore has no intention of resting on its laurels. "We'll soon be using the B&R controllers for our water jet and laser cutting machines as well," announces Stark. The company is also working on integrating its open CAD/CAM software into the con-

troller and, further down the road, providing ERP integration as well.

For an increased degree of automation, imes-core has already developed a laser engraving head and integrated it in the controller. "With this project, we've taken a big step toward our vision of a milling machine that not only completely processes each workpiece start-to-finish, but inspects them as well," says Stark. "With B&R at our side, we have the right partner to go the rest of the way – a partner whose automation expertise and market understanding perfectly complement our many years of experience in the field of CNC." ←



Christoph Stark, CEO, imes-icore GmbH

"The B&R control solution delivered impressively in terms of openness, flexibility and manageability. We also appreciated B&R's ability as a partner to pick up on the latest technology trends and help us channel them into our solutions to our customers' advantage."

Process automation

Model predictive control for all

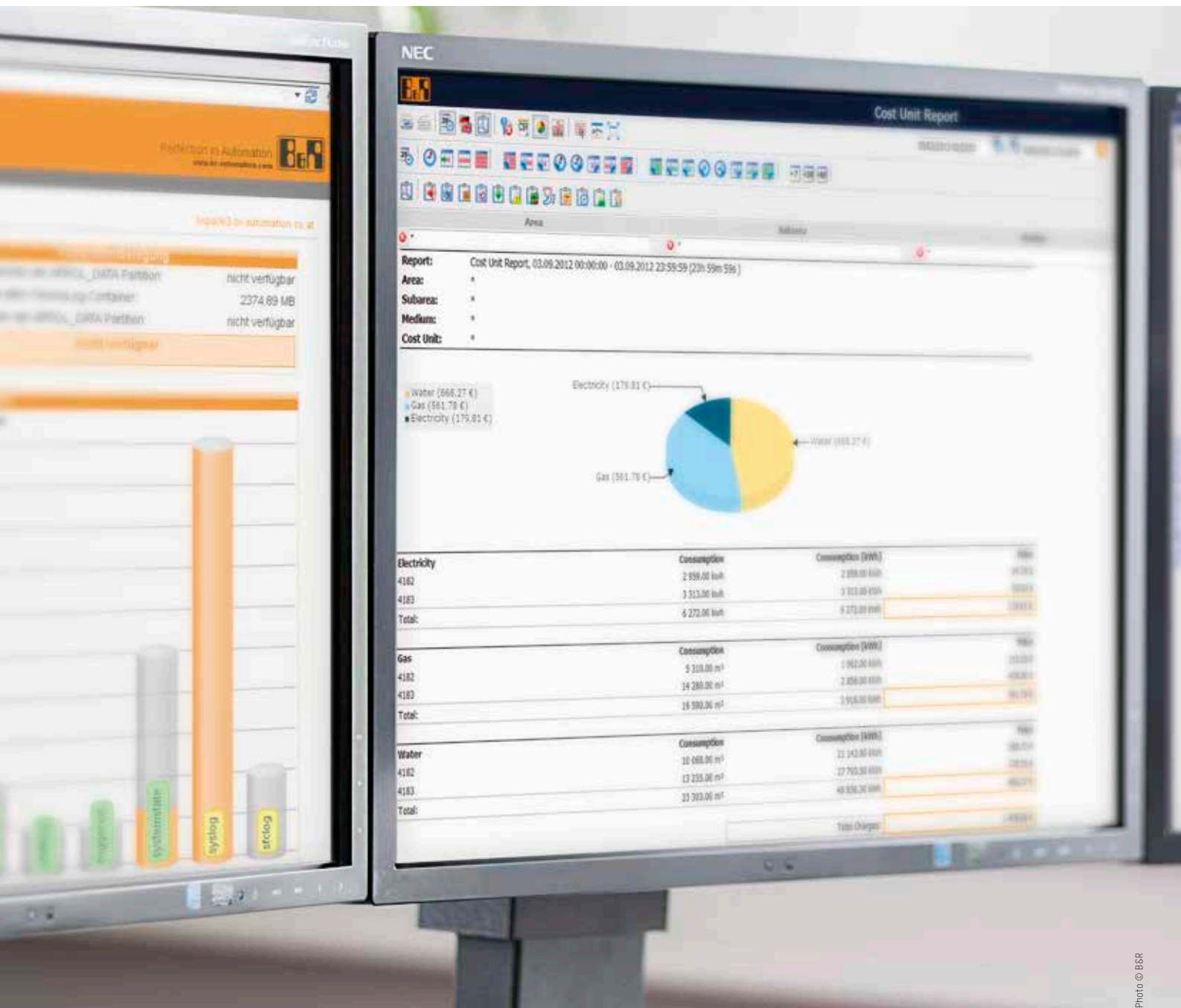
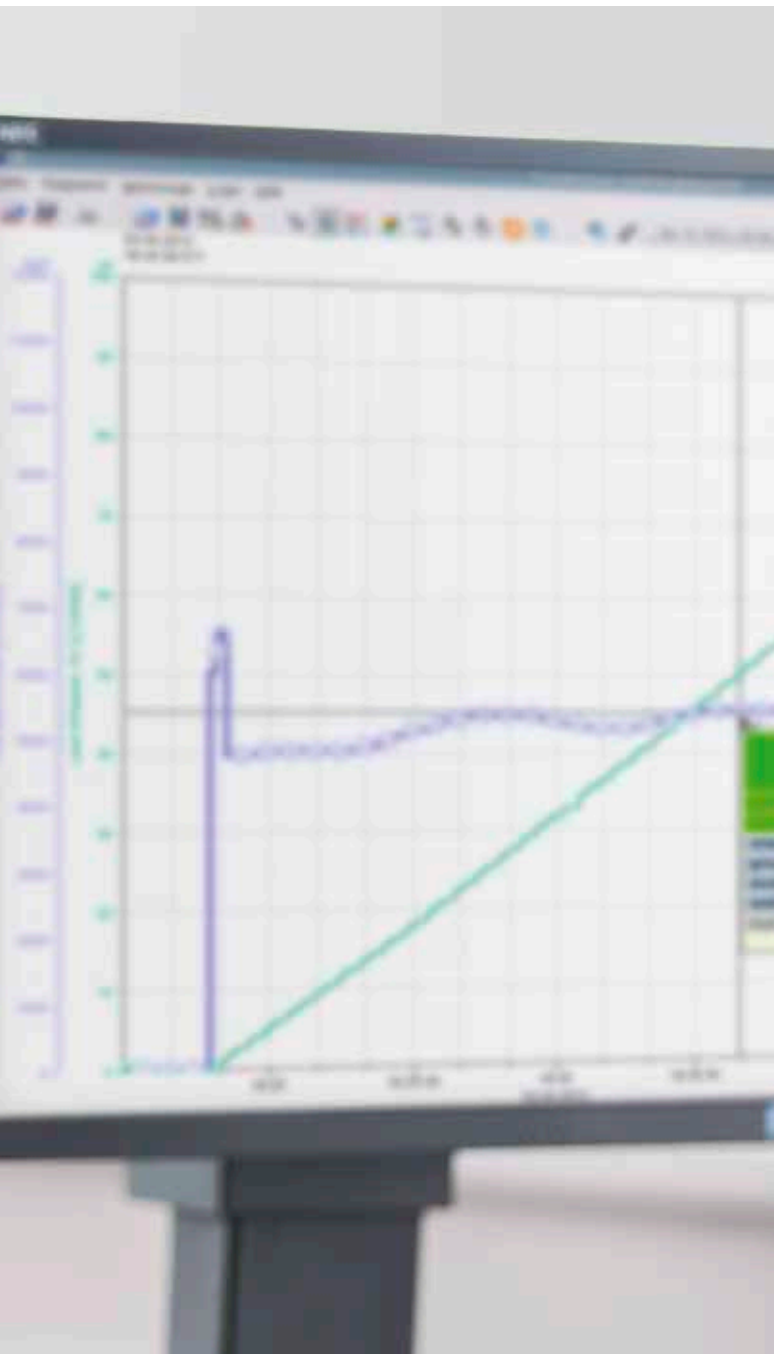


Photo © BSR

The complexity of machine and system processes has increased dramatically over the past few years. As this has happened, conventional PID controllers have run up against their limits. With model predictive controllers, complex processes can be controlled with a much higher degree of precision. Nevertheless, many system operators are still hesitant to latch onto this technology since they consider these controllers to be too labor-intensive – a misconception finally put to rest by the APROL APC solution from B&R.

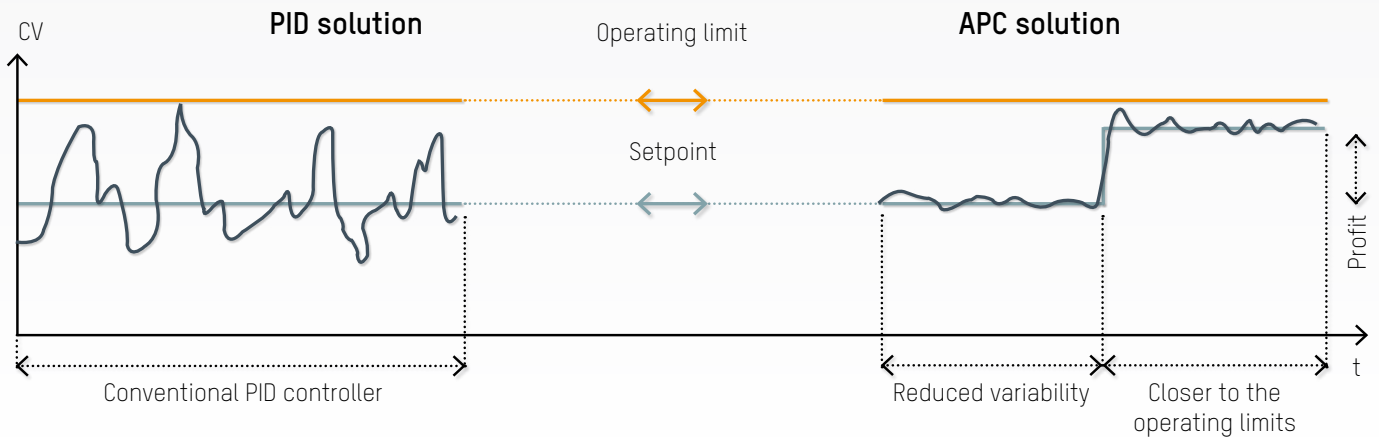


"Advanced Process Control (APC) has been used since the mid-1990s for extremely complex processes with many controlled variables," explains Martin Reichinger, manager of the Process Automation business unit at B&R. A modern refinery, for example, and its countless controlled variables would be nearly impossible to get a handle on with conventional PID controllers. Not only was external processing power necessary to implement APC solutions in the past, it also required engineers specially dedicated to that particular field. "These experiences are to blame for the negative opinion of many system operators when it comes to advanced process control, which has now found its way to model predictive controllers."

Closer to the operating limits

This does not negate the fact that even less complex processes would benefit from the use of model predictive controllers. "Systems and machines would be able to run much closer to their operating limits if predictive control were employed," explains Reichinger. In order to survive in a fiercely competitive environment, production processes and energy consumption must be optimized throughout. "Advanced control technologies open up a broad range of decisive advantages for system and machine operators," says Reichinger.

A conventional PID controller reacts exclusively to control deviations without really getting to know the internal characteristics of the controlled system. In contrast, model predictive control is based on a process model that is used to optimize the manipulated variables on the MPC controller, improving the ability to account for events that are predictable but have not yet occurred. This includes production planning data as well as setpoint changes and disturbance variables. Considerably increased control quality is the result, especially on coupled MIMO systems.



With an MPC controller, a process would be able to run much closer to its operating limits without increasing the probability of a safety shutdown.



Martin Reichinger, Business Manager of Process Automation, B&R

"Our integrated model predictive controller is as easy to operate as a PID controller."

Reduce wear, save compressed air

Depending on the process, there are enormous advantages to be had. Throughput is increased, fewer resources and raw materials are needed and it is even possible to save on expensive compressed air in pneumatic applications. Since the control procedures are more stable and oscillate less, overall wear is reduced as well.

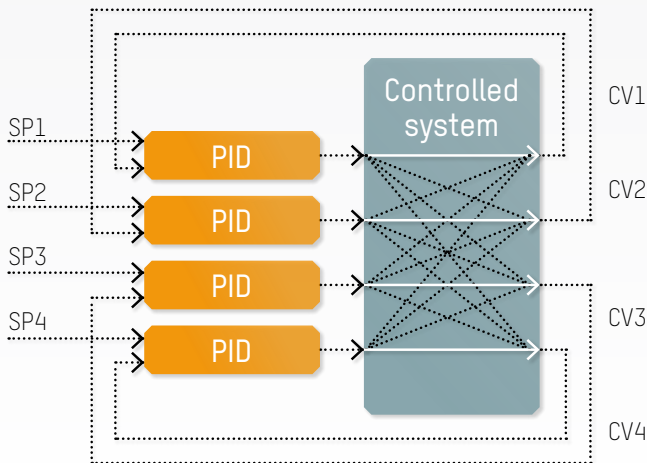
One of the many applications for MPC involves screw presses in wastewater treatment facilities. "We had one case where a screw press with a PID controller was being operated far below its operating limits," recalls Reichinger. Despite that, the pressure in the press still wound up increasing to the point where a safety shutdown was initiated and the system was brought to a standstill for

a period of several hours. Since switching over to a model predictive controller with APROL APC, a safety shutdown has not occurred a single time.

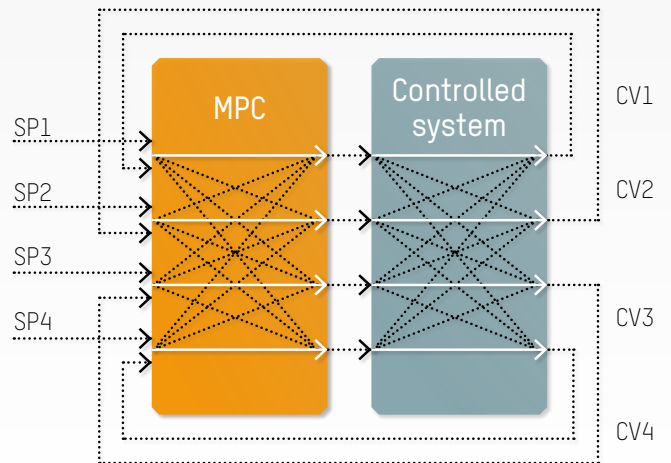
As easy as a PID controller

"The decisive advantage of this solution is that our MPC controller is as easy to operate as a normal PID controller," says Reichinger. Model predictive controllers can also be implemented with standard hardware. The Process Automation Library included with B&R's APROL process control system comes stock with a model predictive controller capable of mastering one controlled variable and one manipulated variable while taking into account a disturbance input (MPC 1x1x1). This makes it possible to

Conventional single-input closed loop control



Multiple-input multiple-output (MIMO) closed loop control



SP = Setpoint, CV = Controlled variable, PID = Conventional PID controller, MPC = Model-predictive control

Whereas a PID controller can only control one value at a time, an MPC controller also takes into account the interactions (couplings) between the controlled systems in its calculations.

replace a sluggish PID controller and save money that would otherwise be spent on additional wiring.

Since the control characteristics of the MPC can also take limits into account, the calculated trajectory is also correct. The MPC module is also available in a variant for up to 10 controlled variables, disturbance variables and manipulated variables (MPC 10x10x10), making it possible to quickly and easily implement highly complex, multidimensional control solutions with a single block for things like automating distillation columns.

Perfect control despite dead time

An MPC controller is especially useful when used in processes with long dead time. "In mining, long conveyor belts for supplying the grinding plant with ore are very common," says Reichinger. If the speed of the belt is increased only when more material is needed at its end, then it takes quite a long time for the process to return to its optimal state. Large buffers are also sometimes necessary to get the process back up and running again. This can be counteracted by a model predictive controller that can react even before the control deviation occurs.

The advantages

- Perfect control for complex processes
- Implemented with standard hardware
- Easy operation
- Easy to integrate

Model predictive control isn't just available to those using the APR-ROL process control system. As a compact, completely configured system – which includes an industrial PC with preinstalled process control system, an MPC block and controller – APR-ROL MPC can be easily integrated into any existing process control based system as a turnkey solution. All that is left to do is connect the inputs and outputs via any fieldbus and configure the MPC block. The use of ready-made modules means that expert know-how is not required to operate the MPC. Trend and alarm systems are included, as are faceplates for facilitating user interaction. ←

"Dealing with data creatively using exploratory data analysis"

B&R has upgraded the APROL automation platform by adding a powerful system component for business intelligence (BI). Martin Reichinger, business manager at B&R, explains how big data can be collected, analyzed and organized to optimize production processes.



What does business intelligence really mean?

Since the early 1990s, BI has played an important role in business management applications. Business intelligence generally refers to the procedures and processes for the systematic collection, analysis and presentation of data in electronic form. This aggregate data can be used to efficiently monitor and optimize processes, while the reports and analysis data provide valuable information for making decisions. Existing ERP solutions have some reporting and analysis functions, but they are usually not sufficient to meet requirements. The front end is often only useful for specialist users with IT training. There is therefore a great deal of interest in this market for powerful and easy-to-use BI solutions at the ERP level.

Why is there also a need for business intelligence at the production level?

The amount of data used in production systems has skyrocketed in recent years. Without automated analysis and evaluation, this

data cannot be used to make informed decisions. We often hear the term "big data" in this context. On large systems, collected data can quickly reach gigabyte or even terabyte levels. Such large amounts of data can only be managed when processed systematically.

What steps are necessary to evaluate and organize large amounts of data?

Business intelligence consists mainly of three processing steps: data collection, analysis and presentation. The first step involves the collection of the data. This raw data can come from an ERP system, database or file, for example. It must then be filtered, cleaned up and harmonized before it can be subjected to analysis. Simple analysis is possible with on-line analytical processing (OLAP) cubes. Complex statistical analysis is carried out using methods associated with data mining. The results can then be presented in the form of graphs and tables.



What exactly is meant by data mining?

This refers to detecting patterns in large amounts of data. For example, it allows machine vibrations to be compared during different time periods or even future developments to be predicted. Comparisons between different machines are also possible, of course, making it easier to optimize production processes and prevent total failures by detecting potential disturbances earlier.

How does the APROL business intelligence solution differ from BI solutions included with other automation platforms?

We didn't just develop an interface to some external solution; instead, we have fully integrated BI functions into B&R's APROL process control system. Operation and maintenance are therefore much easier than is the case with other similar products. Reporting functions are available for all APROL users, and additional components for data acquisition and complex analysis can be installed if necessary. These components are also fully integrated in APROL via the BI platform.

Which target groups benefit from the evaluated data?

Use of the reporting functions is not limited to a single target group. Traditional analysis based on reports with fixed content has been replaced by exploratory data analysis, where only the sources of data are defined, not how it is presented. Reports and evaluations can be compiled individually and modified at any time with the ease of drag-and-drop. A manager may want boiled down, summarized performance data, while a process engineer can call up detailed information about an individual process. The data being displayed can be changed, filtered and sorted by normal users.

It used to take IT experts to generate these reports, and they often needed days or weeks to do so. If requirements changed, the specialists had to be called back in. With the BI solution in APROL, this is possible for any user with just a few clicks of the mouse. The reports can even be configured for display on mobile end devices. And server-side authentication means that all data is protected – even in unsecured networks. ←

Laser marking

The mark of true safety

When **Trumpf** began development of their mobile marking laser, they planned to develop the safety solution in-house as well. Those plans changed, however, when B&R introduced its low-cost, integrated safety solution – SafeLOGIC-X. It was exactly what the laser specialists had been looking for.





The broad spectrum of applications for Trumpf industrial lasers include welding, cutting, microprocessing, surface treatment and marking. When engineer Matthias Kauffmann began working at Trumpf in 2013, his first development project was a new mobile marking laser. The goal was to outperform the small number of other devices on the market in terms of quality and safety. This would be no small feat, considering it was the first marking laser Trumpf had ever produced.

A matter of safety

Unlike stationary marking lasers, with a mobile unit the user can't simply shut a safety door. Trumpf would therefore have to

How the mobile marker works

The first thing you notice about the TruMark 5010 Mobile Marker – Trumpf's new mobile marking laser – is its hand-held marking head, which the operator simply presses against the desired component in order to mark it. The TruMark 5010 Mobile Marker complies with Laser Protection Class 1. The safety solution monitors and assesses a variety of physical parameters.

The airtight seal on the hand-held marking head ensures that no laser radiation can escape. When the operator presses the marking head against the desired component, a partial vacuum ensures a tight seal, which is monitored by the safety application. If the head is not pressed properly against the component, the intelligent built-in sensors detect the poor seal and prevent the laser from firing.

A further advantage is the exhaust that is integrated in the head, which removes any vapors or loose material generated in the course of marking. The laser beam is transmitted to the scanner unit via a fiber optic laser cable. At the core of the TruMark 5010 Mobile Marker is a pulsed fiber laser with a high peak power in the infrared range. Together with the base unit, which houses the controllers for both the laser and the safety technology as well as the exhaust unit, it is mounted on a mobile cart.

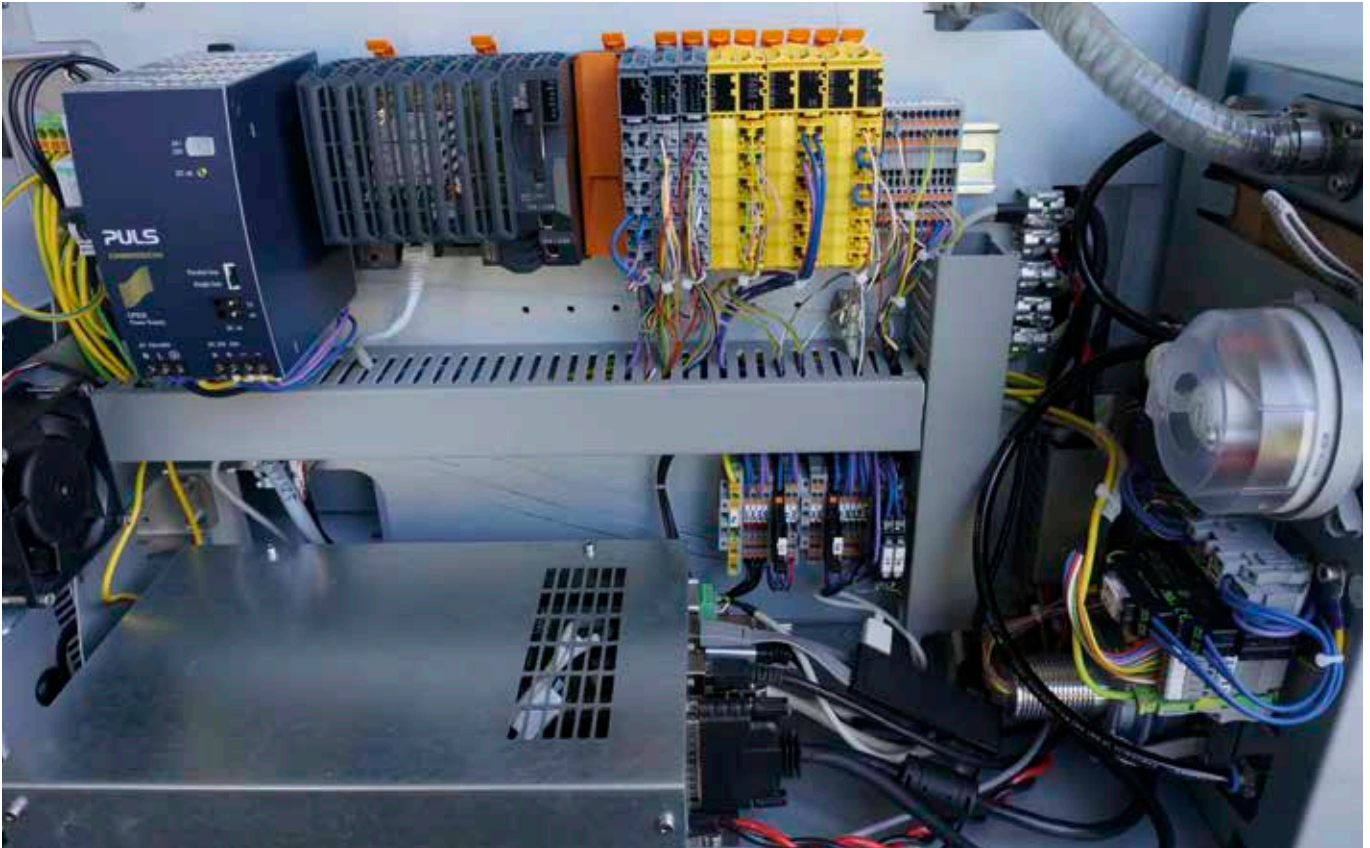


Working without safety glasses: Advanced safety technology such as the SafeLOGIC-X helps the mobile marking laser achieve Class 1 laser protection.

use a partial vacuum to ensure that the hand-held marking head is pressed securely against the surface to be marked. In the event of incomplete contact, the laser must either shut off or be prevented from firing in the first place. "The big questions were therefore: Which sensor signals should we use on the hand-held unit, and how should we use them? What do we need to monitor, and what conditions do we need to rule out in advance? These questions framed the entire development process, especially since a primary goal was to achieve Laser Protection Class 1 certification for the marker. This means that users aren't required to use protective eyewear, even when working with the laser," explains Kauffmann.

Develop our own safety controller?

"B&R did a large portion of the development – actually, more than we had initially planned. Our starting game plan was to use a B&R controller, but just the logic. We would develop the safety inputs – the board in the hand-held unit – ourselves. In other words, our team would handle everything that had to do with POWERLINK and openSAFETY. We have some really good electronics and safety engineers, and the certified safety cutoff solution for our lasers achieves the highest performance level. So we definitely have the know-how," says Kaufmann.



A glance into the interior of the mobile marker prototype: space is tight, so it's a good thing the SafeLOGIC-X (yellow) doesn't need much. On the left is the CPU, with the laser controller at the bottom.



Paolo Salvagno, Managing Director, B&R Switzerland

"With B&R's SafeLOGIC-X, all the advantages of integrated safety technology are finally available to smaller applications as well. This solution covers it all – from safe I/O and drive technology to integrated diagnostics, safe line integration and safe machine options."

Pleasant surprise: SafeLogic-X arrives on the market

Know-how alone was not enough, however – the clock was ticking. One of the main reasons Trumpf had even begun the in-house development in the first place was that the market at the time didn't offer a low-cost safety PLC for small-scale safety applications. Still, Trumpf was on the lookout for alternatives.

According to Kaufmann, since the application's pressure sensors meant the use of analog inputs, the field narrowed quickly. Automation specialist B&R stood at the very top of the list of safety technology providers.

When B&R introduced the first prototypes of its SafeLOGIC-X in 2013, the new solution was a perfect fit for Trumpf's project. The software-based safety controller offered all the advantages of the integrated safety solutions that had previously been out of reach due to their price.

Surprisingly simple safety solution

Behind the SafeLOGIC-X lies a solution that can compete with a conventional hard-wired safety relay in its simplicity. The X in the name hints at the big secret: this safety controller doesn't need any hardware. All of the safety functions are distributed across hardware components that already exist on the network. The safety application itself runs on a safe input module, while all parameter and configuration management tasks are handled on the standard controller. Safe user interface functionality is even handled by the HMI application. The unique architecture of the SafeLOGIC-X is made possible by the openSAFETY standard. This safety protocol provides communication services that comply with SIL 3 requirements and ensures that parameters and configuration data are safely distributed and monitored over the entire network. Since it doesn't require a hardware safety controller, this solution is also referred to as a "virtual safety controller".

"The word virtual can mean everything – or nothing at all."

B&R's virtual safety solution – SafeLOGIC-X – now brings all the advantages of integrated safety technology to smaller, cost-sensitive applications as well. Implemented entirely in software form, SafeLOGIC-X eliminates the need for a hardware safety controller. The safety functions are distributed across hardware components already found on the network – like input modules, standard controllers and HMI devices.

Mr. Kaufmann, what was your impression when you first heard about this virtual safety solution?

"Well, the word 'virtual' is thrown around a lot. It can mean everything – or nothing at all. In this case, though, with the safety controller distributed over multiple components so that you no longer need a physical device, it makes a lot of sense. Knowing what must have been involved in developing such a solution, it is certainly quite an accomplishment. I've got to say, what B&R has done here is impressive."

As a pilot customer, you were one of the first developers to work with SafeLOGIC-X.

"That's right, and it's pretty interesting how it all happened. When we first got serious about SafeLOGIC-X, we had all the most important information and technical data, but still no physical product. So I developed the software on a SafeLOGIC first and then ported it. For us, the important thing was knowing that the module was indeed coming and what it would be capable of. Of course, there are some products where you don't want to be a pilot customer, but with a safety controller we knew it would be certified and were confident that it would work as promised. Based on our past experience with B&R, we knew we would be happy with the results."

Did you consider going with B&R's classic safety PLC, the SafeLOGIC?

"To be honest, the SafeLOGIC would never have fit into our housing. That's why we were so pleased to know the smaller and cheaper SafeLOGIC-X was on the way. It's exactly the right product for us. Our marking laser doesn't need more than a small safety solution. Sure, we have the analog value to deal with, but only four safe digital inputs, which is very little compared to other machines. From a computational standpoint, a SafeLOGIC controller would have been overkill." ←



Interview with
Matthias Kaufmann
development engineer at Trumpf

The advantages of SafeLOGIC and SafeLOGIC-X

The SafeLOGIC-X solution is programmed using the SafeDESIGNER editor in Automation Studio, just like the hardware-based SafeLOGIC solution. This means that when a system outgrows its SafeLOGIC-X solution, it is no trouble at all to switch to a dedicated SafeLOGIC controller. The safety applications can be scaled and configured to meet the requirements of systems of any size. As safe input and output modules are added to a SafeLOGIC safety controller, existing programming code can simply be reused without having to make a single change. Switching over also doesn't require re-certification, another benefit that saves both time and money.

This type of unlimited scalability guarantees system continuity right from the start while also ensuring a uniform approach to engineering and diagnostics – two factors vital to increasing the availability of systems and machines.

The architecture used with SafeLOGIC-X is made possible by the openSAFETY standard. This safety protocol provides communication services that comply with SIL 3 requirements and ensures that parameters and configuration data are safely distributed and monitored over the entire network.

Videos

Real solutions in action

According to Germany's Industry 4.0 working group, Smart Factories and the Internet of Things will be reality by 2025. B&R customers will not have to wait nearly that long, however. This innovative specialist in the field of automation offers technologies and solutions that make it possible to implement tomorrow's machines and systems today.



SPS IPC Drives 2013

In 2013, B&R presented an array of innovations that make machines and plants more modular and flexible with the use of open technologies. In Nuremberg, B&R introduced solutions for implementing aspects of Industry 4.0. Come see us again in 2014 – in Hall 7, Booths 206 and 110!



reACTION technology

Central programming – Distributed execution: The great advantage of reACTION technology. With reACTION technology, B&R is able to reduce response times in industrial automation applications down to 1 μ s. This new approach allows even time-critical subprocesses to be implemented without specialized hardware.



Link: B&R on



Visualization and operation

Whether operation takes place intuitively via touch screen, function keys or a combination of the two, B&R control panels provide unbeatable ergonomic comfort. As with our industrial PCs, these devices are 100% B&R-made, ensuring the long-term availability that machines and systems require.



One tool: Automation Studio 4

Automation Studio 4 is the ultimate tool for machine and systems engineering. Through its sustainable and efficient approach to software development, it will help you keep your quality up, your engineering costs down and your time-to-market short – even in the face of ever-increasing product complexity.



Motion control

B&R's portfolio of motion control technology is fully aligned with its Scalability+ philosophy. This new approach opens up entirely new dimensions for machine builders, making it possible to perfectly tailor an automation solution directly to the needs of a specific machine.

Series-produced machinery

Open safety for flexible mesh welding

Switzerland-based **Schlatter** is a specialist in flexible production lines for all types of wire mesh and lattice girders. Using B&R technology for its new lattice girder production unit, Schlatter was able to transition smoothly from one-off development of highly specialized machines to series production of highly customizable standard machines. Thanks to openSAFETY, every variant shares the same level of advanced safety technology.



At speeds of up to 18 m/min, the CTM310 girder production line provides maximum efficiency even with very small batch sizes.



One might say that wire mesh is *grate*. We find it everywhere, from grills, ovens and refrigerators to shopping carts and store shelves. As a concrete reinforcement or a truss in a prefabricated ceiling, it makes our buildings stronger and more resilient. It is the most frequently used fencing material for demarcating private property or construction sites or restricting access to hazardous areas for industrial safety.

Mesh welders – Made in Switzerland

Schlatter is a specialist in developing the welding and weaving machinery used to produce wire mesh, screens and girders. The Swiss company has achieved its current size and market position through its high level of expertise in two key areas. With its mastery of mid-frequency electrical resistance welding, Schlatter creates seamless connections between railroad tracks and freight truck axles, while exper-

tise in the field of motion control allows it to provide sophisticated coordination of the wire feed and electrode movement required for precision welding.

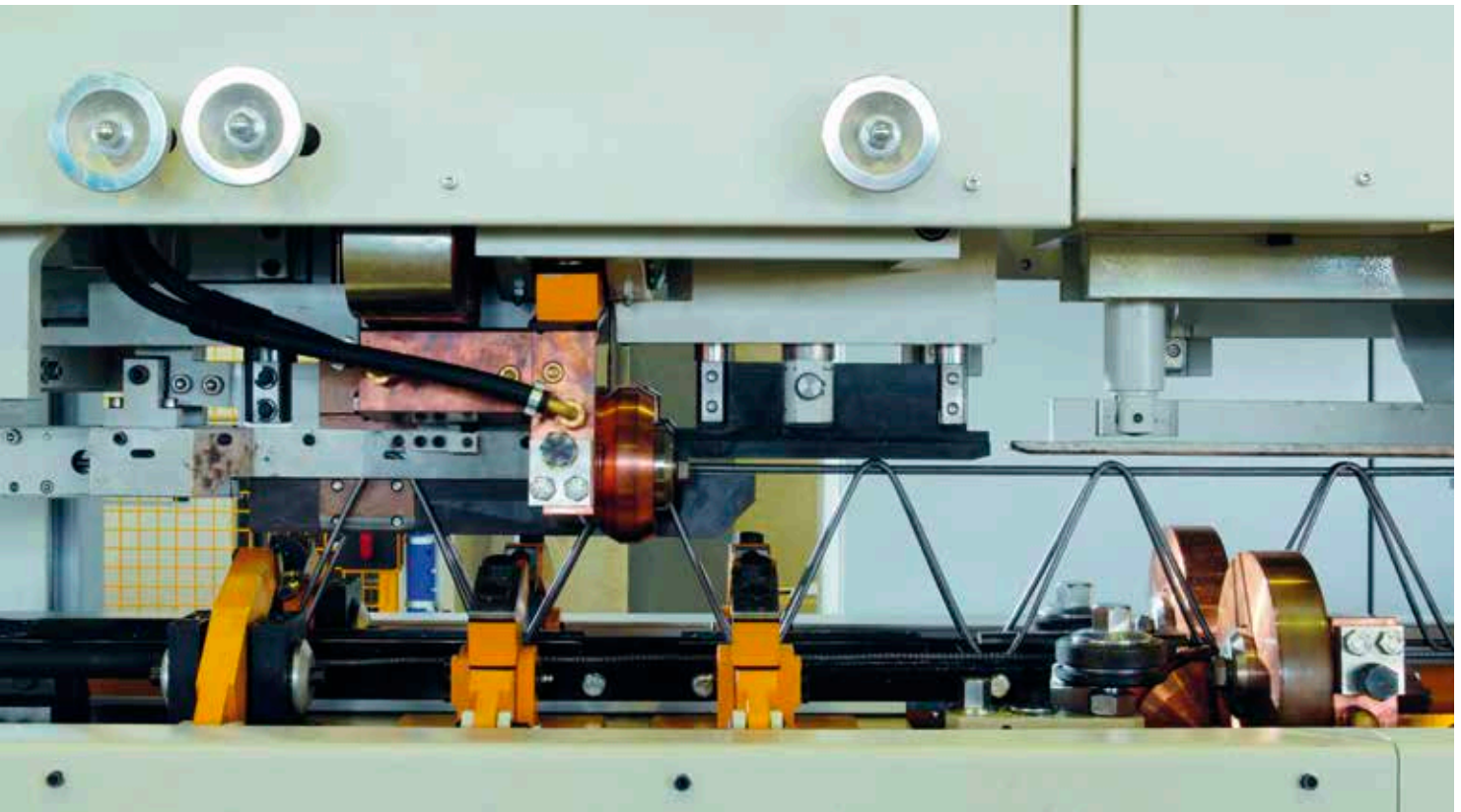
From specialized to standardized

When it came time to develop its new production unit – which creates the lattice girders that stabilize concrete elements used in prefabricated construction – Schlatter adopted an entirely new strategy. "In the past, each Schlatter machine was developed individually for a specific customer," explains technical manager Beat Huber. "Our goal now is to move toward more standardized production. To do this without compromising the flexibility that is so important to our users, we gave the CTM310 a highly modular design." The new solution unwinds wire with a diameter of 5-16 mm from multiple winding tables holding three-ton or five-ton coils and

feeds a belt of four wires into the welding unit, where they are bent and welded. At the final station, the finished girders are cut to length, stacked and bundled for shipping.

Focus on motion control

One of the system's most impressive features is its ability to rapidly accommodate variable wire gauge and girder height. This flexibility allows it to produce girders with specific dimensions in small batches – down to batch size one – while maintaining a high overall output rate. With production speeds up to 18 meters per minute, the quality of the final product relies on synchronizing the movements of the various wires, the hydraulic perforating press and electrode holder. The significance of motion control is reflected in the solution's total of 30 servo motor axes, 16 of them in the welding unit alone.



When developing the CTM310, Schlatter's engineers combined the hydraulic and electronic components into a modular system solution through the use of an intelligent control system and safe motion control.

"One of our primary development goals was to harmonize the integration of hydraulics and electronics with an intelligent control system," recalls electrical engineering manager René Frey.

One of the reasons for this was that Schlatter was looking to let go of old traditions in the selection of an automation system for this new generation. "What impressed us about B&R was the level of integration between control, HMI and motion, as well as the quality of synchronization we could achieve between the many axes using POWERLINK. Another decisive factor was the possibility of implementing a modular safety solution with very little cabling."

All in one, safety too

Higher-level control tasks are handled by an Automation Panel 920 with a 15" XGA color TFT touch screen mounted in the control cabinet of the central welding unit.

The inputs and outputs are controlled by distributed X20 stations on each machine. The servo motors are controlled in pairs by ACOPOSmulti drives featuring SafeMOTION. These provide safe reactions in the event a safety door is opened or a light curtain is tripped on the stacking unit.

"The safety barriers around the system are divided into sectors. That way, the stacking unit can continue to operate if there is a violation in the wire feed sector," explains Frey. The safety application runs on a central SafeLOGIC controller, where the signals from over 30 safe I/O modules come together via the openSAFETY protocol.

Schlatter was able to use the same safety sensors and door locking mechanisms that had proven themselves in earlier generations. "Since integrating preconfigured machine modules in the central safety controller is simply a matter of hooking up

an Ethernet cable, we now spend less time running cables and a whole lot less time on tedious troubleshooting." In the event that a new option needs to be added to an existing machine, it is no longer necessary to shut down the the whole line to perform the wiring.

Accelerated restart

The most-used reaction to safety events is Safe Torque Off (STO), which is included in the portfolio of Smart Safe Reaction options offered on the ACOPOSmulti drives.

"On a fully-equipped line, we're operating close to the maximum number of nodes permitted for one SafeLOGIC controller," says Fabio Giacomini, the software engineer responsible for both the automation software and the safety application. He is particularly happy to be able to develop the safety application in the SafeDESIGNER editor, within the familiar environment of



Schlatter's "MG630 Tailor" is an extraordinarily flexible line that produces complex reinforcement mesh in virtually any geometric pattern.



Dr. Gereon Heinemann
Head of Product Management, Schlatter

"We were able to achieve an unprecedented degree of modularity, which we owe to the use of B&R logic and motion control components, as well as POWERLINK and openSAFETY."

Flexible thanks to openSAFETY

Implementation of openSAFETY was key to giving the new Schlatter machines their exceptional level of modularity. Beyond the drastic reduction in cabling, which in itself was a huge step, modularity was gained through the more advanced diagnostics options and the ability to update the safety application on the SafeLOGIC via remote maintenance, independently of the automation software. "One of Schlatter's greatest strengths is the partnership we offer our customers. Our systems have a service life measured in decades, so effective cooperation and the ability to expand and replace equipment down the road are especially important to us," says Frey. "Being able to replace a defective component without having to manually reset parameters – let alone modify the safety application – makes maintenance much easier for the end user." ←

Automation Studio, and also appreciates the ability to communicate between the standard controller and the SafeLOGIC safety controller.

This allows the automation software to react to safety events, for example by stopping the wire feed when there is an alarm in a downstream unit. And the potential for system-wide control goes much fur-

ther than that. "We use a special trick to get started back up even faster after stopping for a safety event," says Giacomini. "Before the safety reaction – which we have intentionally delayed – takes effect, the standard controller shuts down the system. That allows the machine to be started up much more quickly since all we have to do is acknowledge the safety-related intervention."

Asphalt mixing plants

The trick's in the mix

Asphalt pavement is the go-to material in the road construction industry. To get a final product with just the right properties, you need flexible recipe processing and high-precision dosing.

Benninghoven mixing plants get the right mix every time thanks to their sophisticated BLS3000 control systems, based on B&R's APROL process control technology.



Hans Adam,
Head of Electrical Engineering, Benninghoven GmbH & Co. KG

"With our APROL-based BLS3000, we're able to meet the high demands on investment planning and provide the necessary transparency for documentation of internal processes."



Of the approximately six million miles of paved roads and highways across North America and Europe, between 90 and 95 percent are surfaced with asphalt. On top of that, you have all the asphalt used for parking lots and airport runways, or as sealant for fodder silos and insulation for residential buildings. This versatile material has a multitude of applications that impact virtually every area of our lives. In road construction alone, the many uses of asphalt call for a wide range of different mixtures. These include mixtures aimed at reducing noise pollution, porous mixtures for improved handling of storm water as well as more energy-efficient warm-mix materials that allow paving at lower temperatures. According to the German Asphalt Pavement Association, Germany alone lays around 50 million metric tons of asphalt per year, mixed in more than 700 plants across the country.

Asphalt plants from Germany's Mosel region

In the town of Mülheim an der Mosel, Benninghoven builds the mixing plants needed to meet this tremendous demand. Now in its fourth generation of Benninghoven leadership, the company's 880 employees specialize in the manufacture of asphalt mixing plants, with more than 80 percent vertical integration. These plants are put to use all over the world. The largest of which, a two-tower plant in Finland, has been operating since 2009 with a total output of 720 metric tons per hour.



Mobility is a key requirement in hot recycling of damaged pavement. The mobile drum operates with a heated tilting hinge. Hydraulic legs provide precise vertical positioning.



Specialized tank that stores various types of bitumen to meet recipe requirements with greater flexibility.

New challenges demand new ways of thinking

Benninghoven's success is based on constant observation of market trends and the continuous pursuit of technological improvement. Fifty years ago, there were no more than a handful of recipes to choose from – today the variations are countless. The aspects of environmental protection and conservation of resources are driving research into materials that can be processed at ever lower temperatures. The share of recycled material included in the mix has grown to over 90 percent. Special mixing techniques and additives allow for lower mixing and laying temperatures, which in turn improves working conditions, allows for cold-weather paving and makes the finished surface available for use sooner. In addition to being more environmentally sound, advanced production methods also improve the durability of roadway surfaces. New processes such as emulsifying the bitumen in water help improve both the energy efficiency of production as well as the quality of the mixture.

Modular process control system

The challenges of state-of-the-art asphalt mixing have led to a steadily rising degree of automation. Benninghoven recognized

that its previous controller was no longer able to handle the increasingly complex requirements. "Even before we began our evaluation, it was clear that we would no longer be able to do without the functionality of a full-fledged process control system," recalls Hans Adam, head of Benninghoven's electrical engineering department. A primary focus during development was integrating the real-time system – i.e. direct control of the process – in order to handle the complex new recipes and ensure high-precision dosing and quality control. Another key requirement arose from the large numbers of individual software modules that would need to be mixed and matched to provide the required functions for any given project.

B&R's APROL process control tees it up

"We saw quickly that even a conventional process control system couldn't meet these requirements," explains Adam. "Then we came across B&R's APROL process control system and X20/X67 controllers at the 2008 SPS/IPC/DRIVES in Nuremberg. Even before B&R had finished their presentation, we knew APROL came very close to exactly what we were looking for."

APROL

Centralized acquisition of data from machines and systems enables comprehensive online performance monitoring and visualization. Long-term archiving ensures the ability to assess the quality of the manufacturing process. Integrated reports provide detailed analysis of all process data in order to optimize production processes. Combined display of continuous data, alarms and events in the TrendViewer make it easy to trace cause and effect.



The mobile mixing plant with a silo that holds up to 30 tons of material and can be loaded directly from a truck.

The controller that Benninghoven developed around APROL, the BLS3000, is now a standard feature of every plant the company builds. The distributed architecture of the automation level and the excellent support for migration make it particularly well-suited for modernizing plants with outdated technology.

Modular structure eases development

Each of the plant's subsystems is defined as a technology module. The hardware designers are able to select freely from B&R's entire range of X20 and X27 components. The rugged X67 modules are particularly helpful since they eliminate the inconvenient control cabinet installation otherwise required in harsh environments. Thanks to jitter-free communication over the fast real-time POWERLINK fieldbus, dosing data can be transferred with more than enough precision and synchronization. The absolute freedom in the selection of a network topology further facilitates this approach. "What also spoke in favor of B&R was the fact that the system design wouldn't have to be reworked in the future to accommodate the safety technology we plan to add," adds Adam.

Complete in-house engineering safeguards know-how

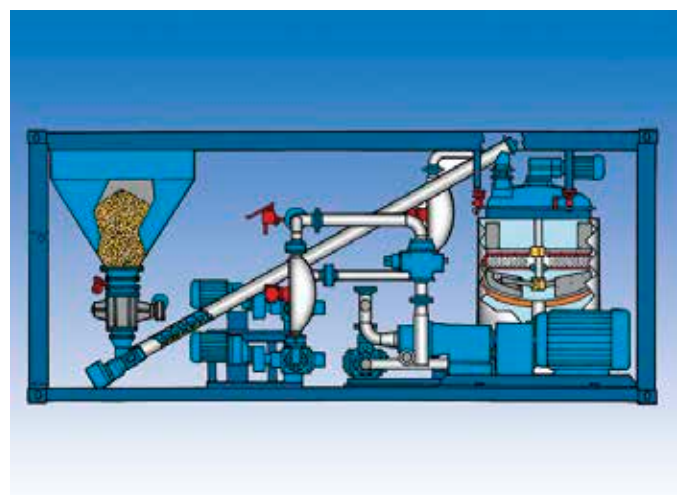
On the software end, the individual technology functions are implemented in object-oriented form as hyper macros, all developed fully in-house. For the basic system functions, Benninghoven's developers drew from the extensive APROL function libraries, which allows them to profit from their continuous development and testing. "It was important that we keep our know-how in our own hands," says Adam, "because that's our key to differentiating ourselves on the market."

When a new plant is developed, engineers at various locations draw from the central database of software modules to assemble

the functions they need. By providing this capability, APROL has the additional benefit of making teams more productive.

In the fast lane to success

Many of the functions introduced by Benninghoven are now being requested explicitly in the design specifications presented by construction firms – a fact that gives Adam and his colleagues confidence that they are on the right track. "When our plant control system is winning us large international contracts, that tells us we made the right decision." ←



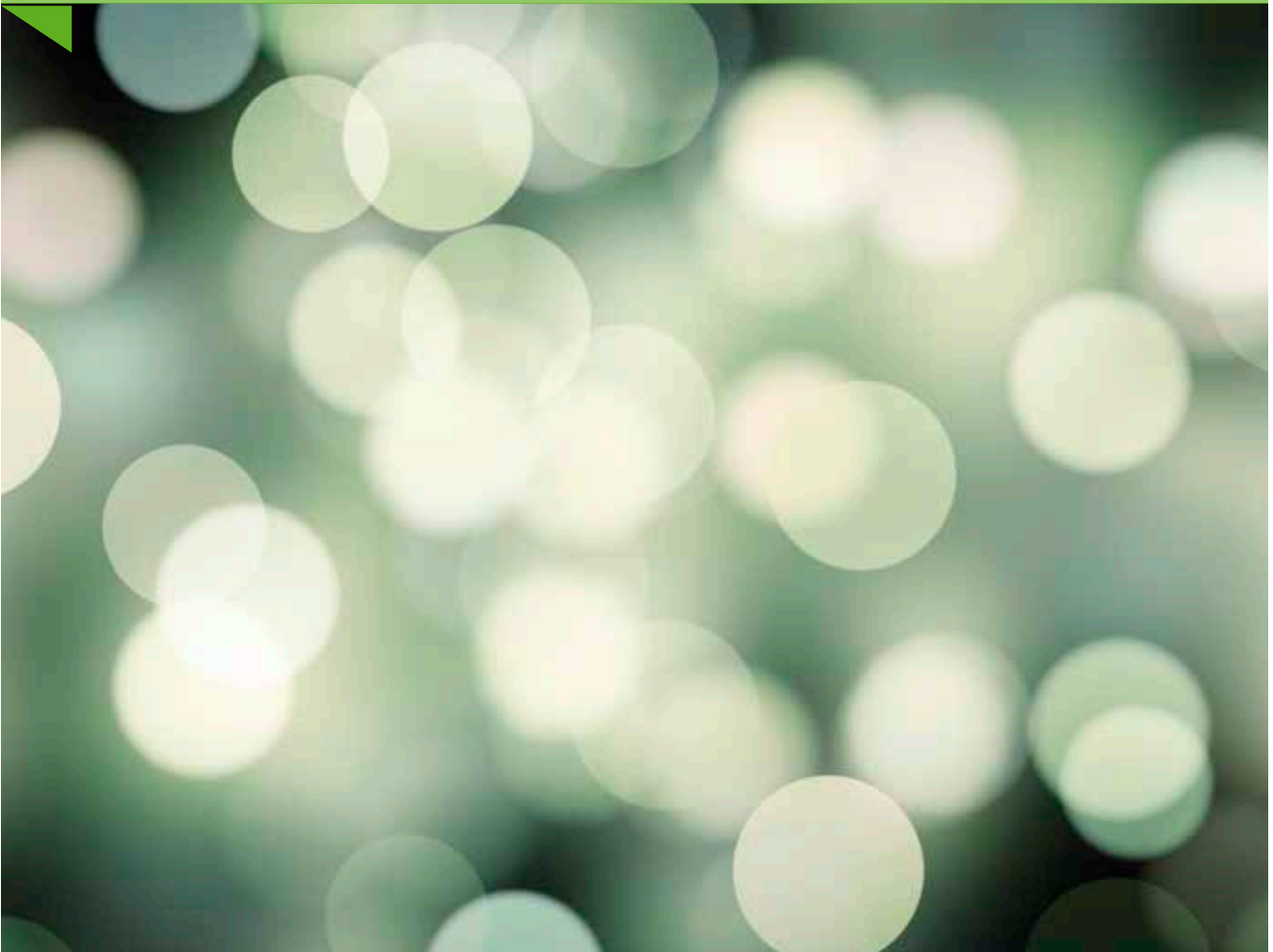
Bitumen container with 30 m³/h output.

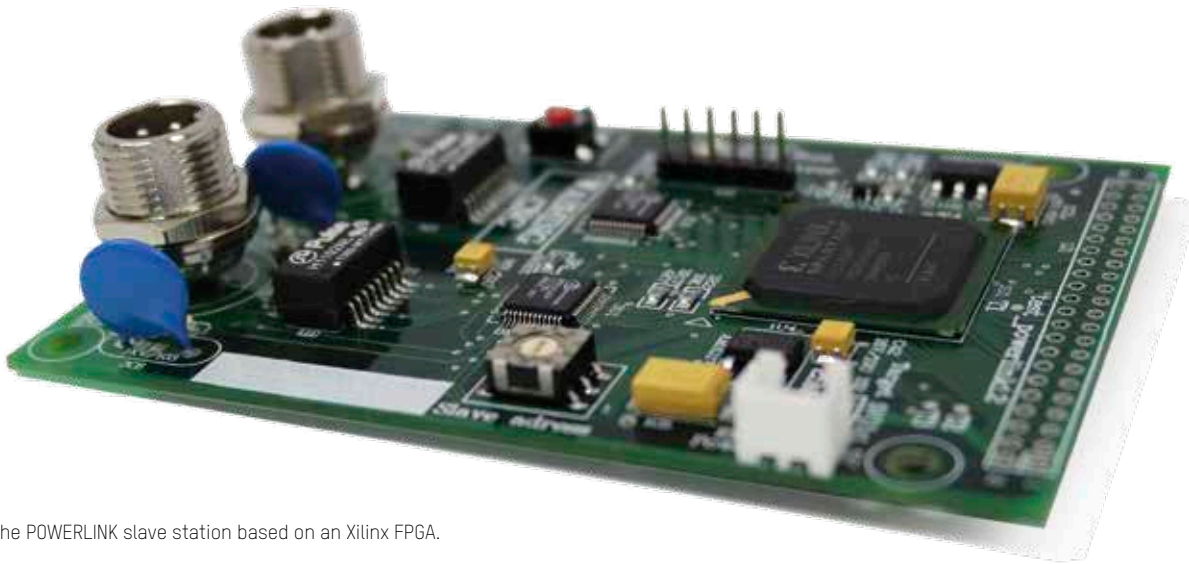
CNC controllers

100 μ s on

CNC controllers

NanJing Washing CNC has been developing CNC controllers for 10 years. Last year, the company sold 8,000 CNC controllers – making it one of the top three suppliers in China. With its newest CNC controller, Washing CNC used POWERLINK to reduce the cycle time to an astonishing 100 μ s.





The POWERLINK slave station based on an Xilinx FPGA.



Customer requirements are constantly evolving, and the number of competitors in the field of automated control systems is growing steadily. At the same time, expectations for ever greater precision, processing speed and functionality demand more and more performance from the bus system. Since 2010, Washing CNC has been working on a new CNC controller that delivers this performance. When developing this cutting-edge project, requirements included the use of non-proprietary technology as well as staying within a competitive budget.

Against this backdrop, POWERLINK – an open real-time communication protocol – became a key element in Washing CNC's solution. The technology behind this Ethernet standard provides uncompromising

performance and real-time capabilities based on the established global standard as defined by IEEE 802.3. Using POWERLINK not only reduced overall wiring – and the associated costs – but also opened up new machine design possibilities.

A strategic choice

For the developers, it was especially important to select the platform best-suited to their needs. Together with the development team, CEO Zhelu Li, for whom this long-term project is of great importance, decided to base the new high-performance CNC controller on POWERLINK. Developing a controller such as this requires not only extensive technical expertise, but also broad experience in software development. The engineers at Washing CNC have gathered this experience through the develop-

ment of FPGA- and ARM-based hardware platforms as well as software based on Linux and Windows CE.

CNC controller with cycle times <100 µs

Zhelu Li tasked his development team with building a CNC controller that was up to international standards and able to handle large volumes of process data while also achieving cycle times under 100 µs. This was the type of technology Washing CNC would need in order to maintain its market leadership through the next 5 to 10 years.

POWERLINK can run on a wide range of platforms, including ARM, Power PC, Intel x86 and FPGA. The WA730/740 series that Washing CNC was planning include high-end CNC controllers with exacting demands on real-time behavior.

ETHERNET POWERLINK

As a successor to classic fieldbus technology, POWERLINK provides uncompromising performance and real-time capabilities based on the established global standard, Ethernet. A transmission speed of 100 Mbit/s and a synchronization accuracy of < 100 ns allow even the most demanding tasks in the areas of control engineering, robotics, CNC and motion control to be combined in a single network.



The new WA730/740 series were first introduced in 2013 at the Industrial Automation Show (IAS).

An FPGA is the optimal platform for this type of task. The decision was made in favor of an FPGA chip from Xilinx, which offers clock synchronization with jitter values between 20 and 60 ns. This chip provides the hardware basis for integrating POWERLINK into the new high-performance CNC controller.

Complete solution platform

The open-source POWERLINK project includes not only the source code for the POWERLINK stack, but also a complete

system for developing the network interface and configuring network communication. It offers developers numerous tools for developing reference circuits, coding and documentation as well as testing tools such as the XDD checker and the openCONFORMANCE tool. The openCONFIGURATOR tool for network configuration can be used as a plug-in for engineering tools. The open-source diagnostic tool Wireshark can be used to analyze the system and simplify the development process.

Peak performance

Washing CNC first introduced the new WA730/740 series in 2013 at the Industrial Automation Show (IAS). Washing CNC and its POWERLINK-enabled products impressed visitors with 100 μ s response times.

POWERLINK has earned its position at the heart of Washing CNC's solutions, and the company has plans to continue developing and improving its POWERLINK-based product series to meet the specific needs of its customers. ←

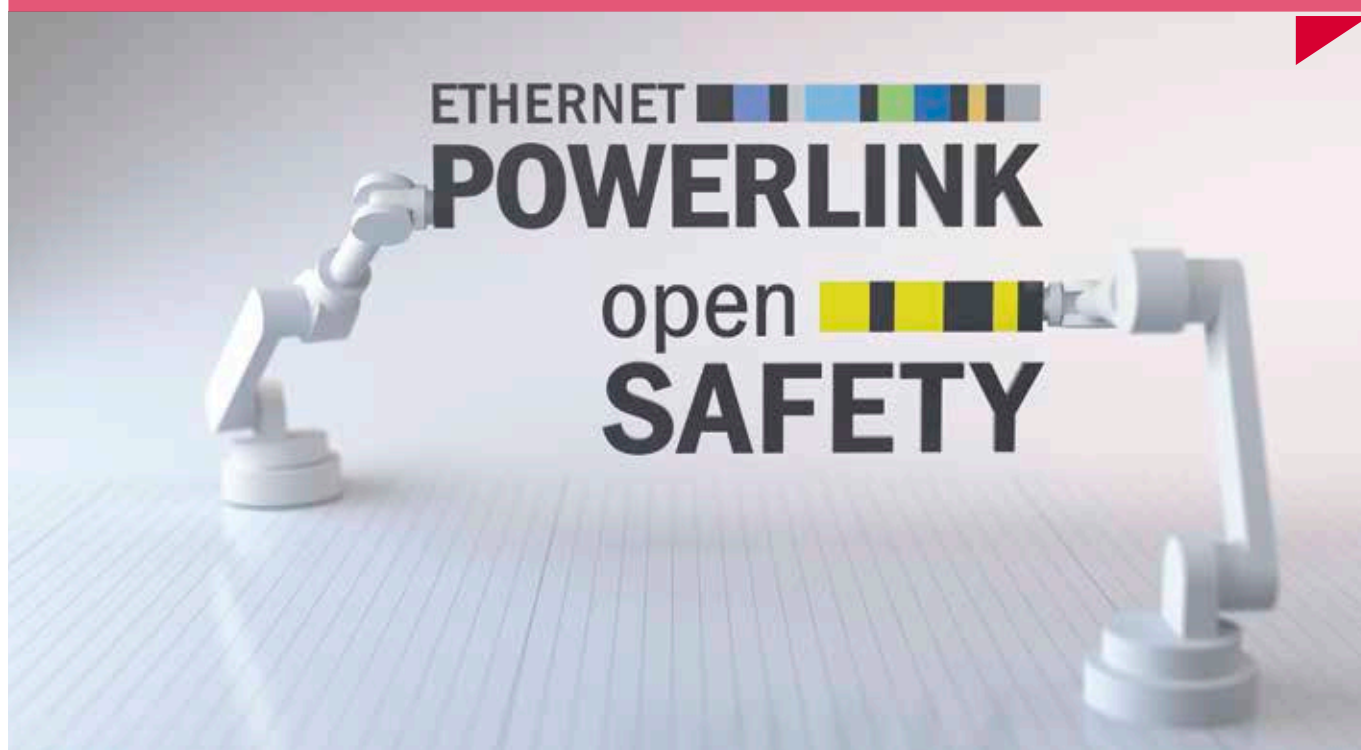


Jiang Chen, Director of Research & Development, Washing CNC

"The development team was tasked with building a high-end CNC controller up to international standards that can handle large volumes of process data while also achieving cycle times under 100 μ s. This is the type of technology we need in order to maintain our market leadership through the next 5 to 10 years."

How to talk to robots

Industrial robots are becoming an increasingly common feature of modern production lines. During both initial setup and normal operation, they need to work safely in close proximity with human operators. The choice of a communication protocol plays a decisive role in making this possible. POWERLINK and openSAFETY have established themselves as the perfect backbone for applications involving robotics.



Robots are taking on a growing range of responsibilities for tasks that are too difficult or dangerous for humans, such as lifting heavy loads or feeding workpieces into a milling machine. When it comes to solutions that involve robots, there are always three main requirements that must be kept in mind:

- Precise and responsive motion control
- A powerful controller
- High-speed internal communication

In the past, satisfying these requirements generally meant using proprietary systems or specialized hardware. "Today, open technol-

ogy and standard components are advancing steadily," says Stefan Schönegger, managing director of the EPSG. "That's the only way to guarantee that investments in machines and plants are protected."

Mastering complex robotic systems

At the same time, machines whose automation includes robots frequently have other axes with which the robotic movements must be synchronized. One such scenario could involve a robotic arm that needs a different tool to complete the processing of a workpiece, for example. To do this, the arm moves linearly along an axis to the tool magazine, picks up the new tool and then moves back to its original position.



Increasing numbers of machines are incorporating robotic components. Ideally, they play an integral part in the overall automation solution.

Not only is tight axis synchronization essential to the machine's precision, it also increases the speed of the system as a whole. Here, too, the common practice has been to use proprietary solutions, with the result that robots and other axes rely on two separate control systems. "Establishing uniform communication across the entire line is virtually impossible with this approach," explains Schönegger. "And until now, users have been stuck with the consequences: impeded system performance and more expensive, time-consuming commissioning and maintenance."

High-speed data transfer in large networks

POWERLINK delivers its fast response times even over large networks with heavy traffic. As a real-time communication standard, it transmits data in individual telegrams that arrive directly at the

receiver without delay. Its cross-communication capabilities also make it possible for intelligent field devices to bypass the network master and exchange data directly, allowing robots to directly share data among themselves as well as with other machine axes, for example. This is one of the clear advantages behind POWERLINK technology.

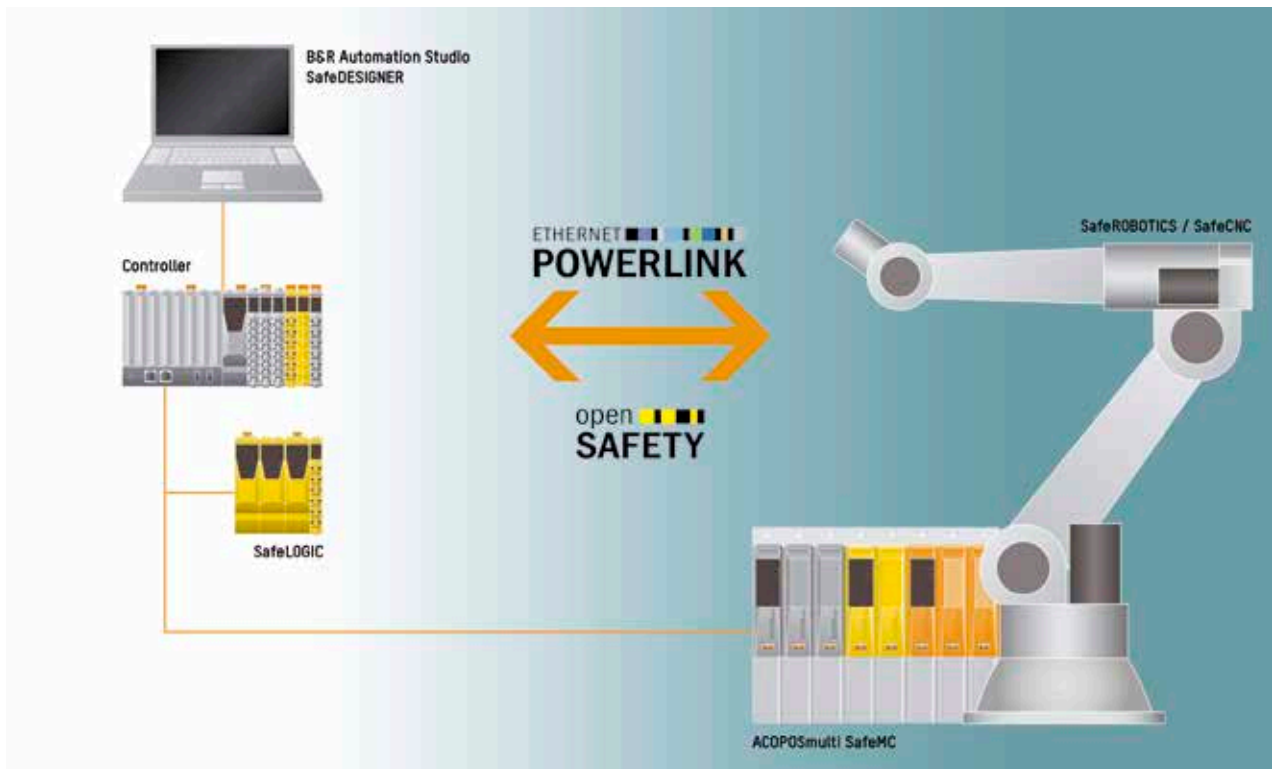
With multiplexing, data can be transmitted exactly when it is needed. This allows time-critical nodes to be handled in every network cycle, while data from non-time-critical nodes is transmitted in every *n*th cycle. The foil stretching machine from Brückner, for example, demands absolute synchronization of its 728 axes, which receive their position values precisely every 400 μ s. At the same time, non-time-critical temperature control plays an important role in product quality.

open SAFETY

With openSAFETY as the safety protocol, applications can be implemented with Cat. 4 / SIL 3 / PL e protection, allowing robots to respond intelligently to dangerous situations, for example by safely limiting the speed at the tool center point.

ETHERNET POWERLINK

POWERLINK masters the challenges of integrating robotics like no other system on the market – particularly through its ability to guarantee hard real-time capabilities, even in very large networks.



With POWERLINK, robots become an integral element of the automation system, while openSAFETY adds the benefits of intelligent systemwide safety functions. B&R is one of the EPSG members already offering this type of solution.

POWERLINK also offers users complete network design freedom – supporting star, bus and ring topologies or any combination thereof. The open protocol allows failsafe networks to be implemented with line and master redundancy without requiring any special hardware. This ensures that operation is not affected by network connectivity problems. These features give machine builders free reign during conceptual design, allow robotic systems to be integrated anywhere they are needed and guarantee maximum availability.

Free selection of hardware manufacturer

Today's solutions need a real-time Ethernet protocol that provides high-speed data transfer as well as openness. That's why more and more robotics users are choosing POWERLINK. Available as an open source stack at www.sourceforge.net, this software-based protocol helps companies avoid dependence on specific hardware manufacturers. POWERLINK also complies with the recognized IEEE 802.3 Ethernet standard and offers hard real-time capabilities.

Another key requirement of a communication protocol is reliable synchronization of all axes. "While there are a number of industrial Ethernet systems that have the necessary bandwidth, in some cases the transfer rate drops dramatically as you add axes," says Schönegger.

Systemwide safety for production lines

If you want the flexibility to do away with safety gates in order to place robots on the production line where they are most effective, you will need an intelligent safety solution in place. If your plant

integrates machines from multiple manufacturers, you will also need a safety protocol able to communicate across the entire line. "That's the only way you can be sure that every machine in the line will react correctly to safety-related events," says Schönegger.

openSAFETY is the only safety protocol that lets you transfer safety data over any type of bus or network connection. Using openSAFETY technology has many advantages. Faster response times allow for reduced safety clearances and a smaller machine footprint, for example. System operators also profit from faster commissioning and changeover times thanks to automated parameterization and configuration services. "This improves system availability and boosts overall productivity," says Schönegger.



Stefan Schönegger, Managing Director, EPSG

"There is growing market demand for open technologies like POWERLINK."

openSAFETY guarantees extremely short response times and allows motion control systems to provide much more intelligent reactions than a simple all-out stop. This involves the use of dedicated safe robotics functions such as safely limiting the speed at the tool center point. ←

One cable for everything



openSAFETY control panels from B&R allow safety data to be transferred via the bus system.

New openSAFETY control panels from B&R allow safe data exchange over the bus system. The integrated openSAFETY interface renders the hard wiring of E-stop, operating mode and start buttons obsolete.



Simple cabling of swing arm systems

Settings up control panels with several hard-wired switches and buttons by threading countless cables up through the swing arm system is nothing but a headache. openSAFETY control panels, on the other hand, only require a bus and power connection. This means that these systems can be placed exactly where they are needed without having to deal with unwieldy cable harnesses. Commissioning and service are also simplified, saving additional money in these areas as well. The E-stop button is just as reliable as its hard-wired counterparts.

Arrange buttons and switches as needed

These control panels are available in a wide range of configurations, allowing them to be tailored perfectly to any application. In addition to different display sizes and ratios, it is also possible to choose between various touch technologies. Just as configurable are the number and arrangement of buttons, switches and the E-stop button. The control panels are also available in housings rated up to IP65. And to round it off, B&R can customize these devices for specific clients and offer solutions for specific industries, such as food and beverages. ←

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