

# automation <sup>05.18</sup>

The B&R Technology Magazine

Intelligent transport system

Digitalization on track

Industrial IoT Greater efficiency for machinery and equipment

Mobile automation Reliable giants

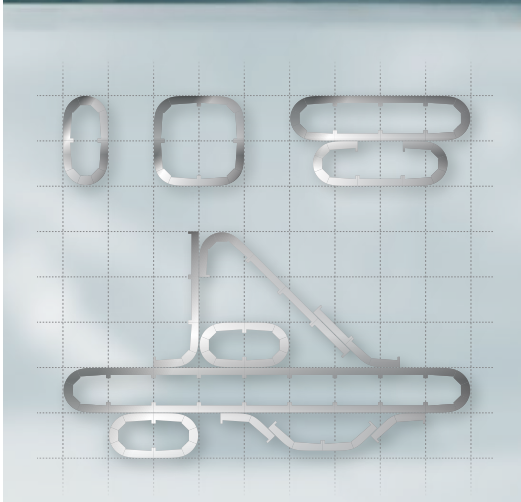
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High-speed diverters



Track design flexibility



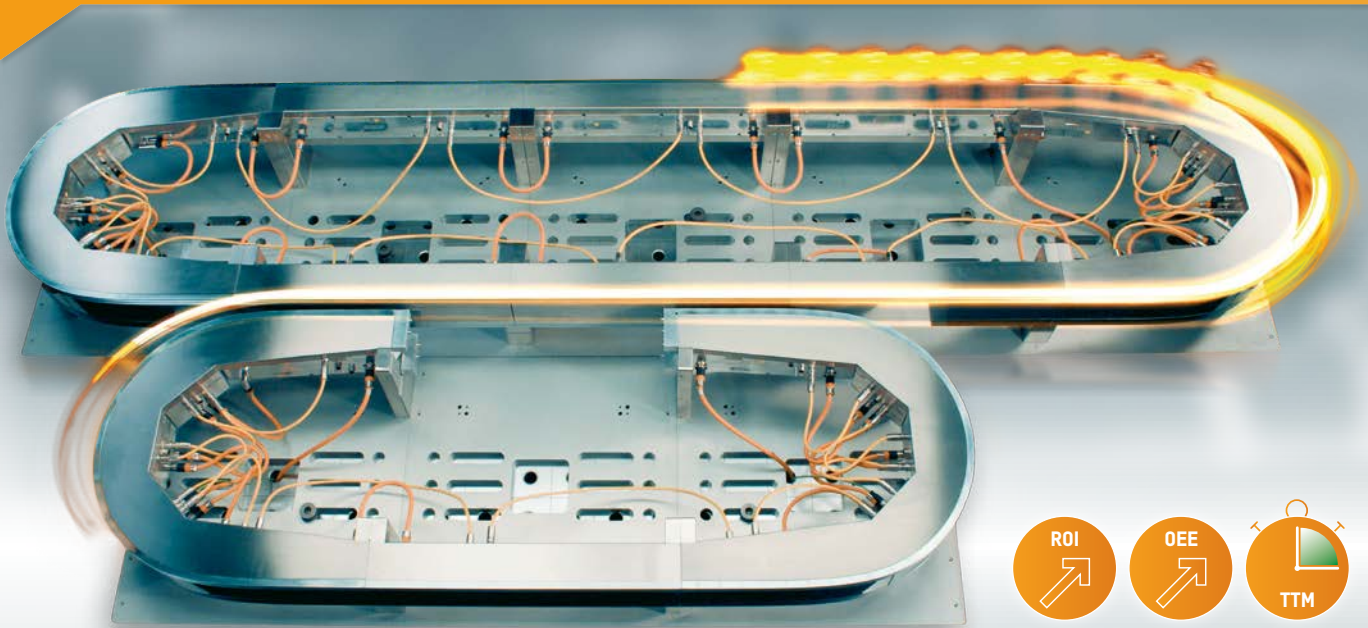
Purely magnetic holding



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# editorial

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[automation@br-automation.com](mailto:automation@br-automation.com)

Managing Director: Hans Wimmer

Editor: Alexandra Fabitsch  
Editorial staff: Craig Potter  
Authors in this edition:  
Carmen Klingler-Deiseroth, Franz Joachim  
Rossmann, Kara Knox, Caroline Turesson, Stefan  
Hensel, Ninad Deshpande, Andreas Leu, Karel  
Sedláček, Michaela Stern, Alexandra Fabitsch

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**Dear Reader,**

No longer just an industry buzzword, digitalization has become an integral part of our daily lives – from the smartphones in our pockets to the personalized products in our online shopping carts. Like never before, our purchases are an expression of our personality, and the items are fine-tuned to our needs and preferences.

The term digitalization seems to suggest that it's all about the digital world of computers, communication networks and the Internet. Yet, that's only half the story: what we need are new ways to approach the digital world from the context of everyday life on the factory floor.

B&R is working intensively on solutions for the Industrial IoT, cloud services and OPC UA TSN communication. At the same time, we're also doing exciting things with ACOPOStrak – our highly flexible transport system that will play a central role in implementing mass customization in production lines around the world.

Its unique design inspires entirely new ways of thinking about manufacturing systems. Its high-speed diverters and nearly endless track layout possibilities open up new dimensions of machine design freedom. The hot-swappable shuttles reduce change-over times to a minimum, and sophisticated software makes the system efficient and intuitive to use.

In this issue of *automation*, you can read all about how ACOPOStrak makes personalized production efficient and profitable like no other transport system can.

Happy reading!

Michael Brucker  
Project Manager - ACOPOStrak



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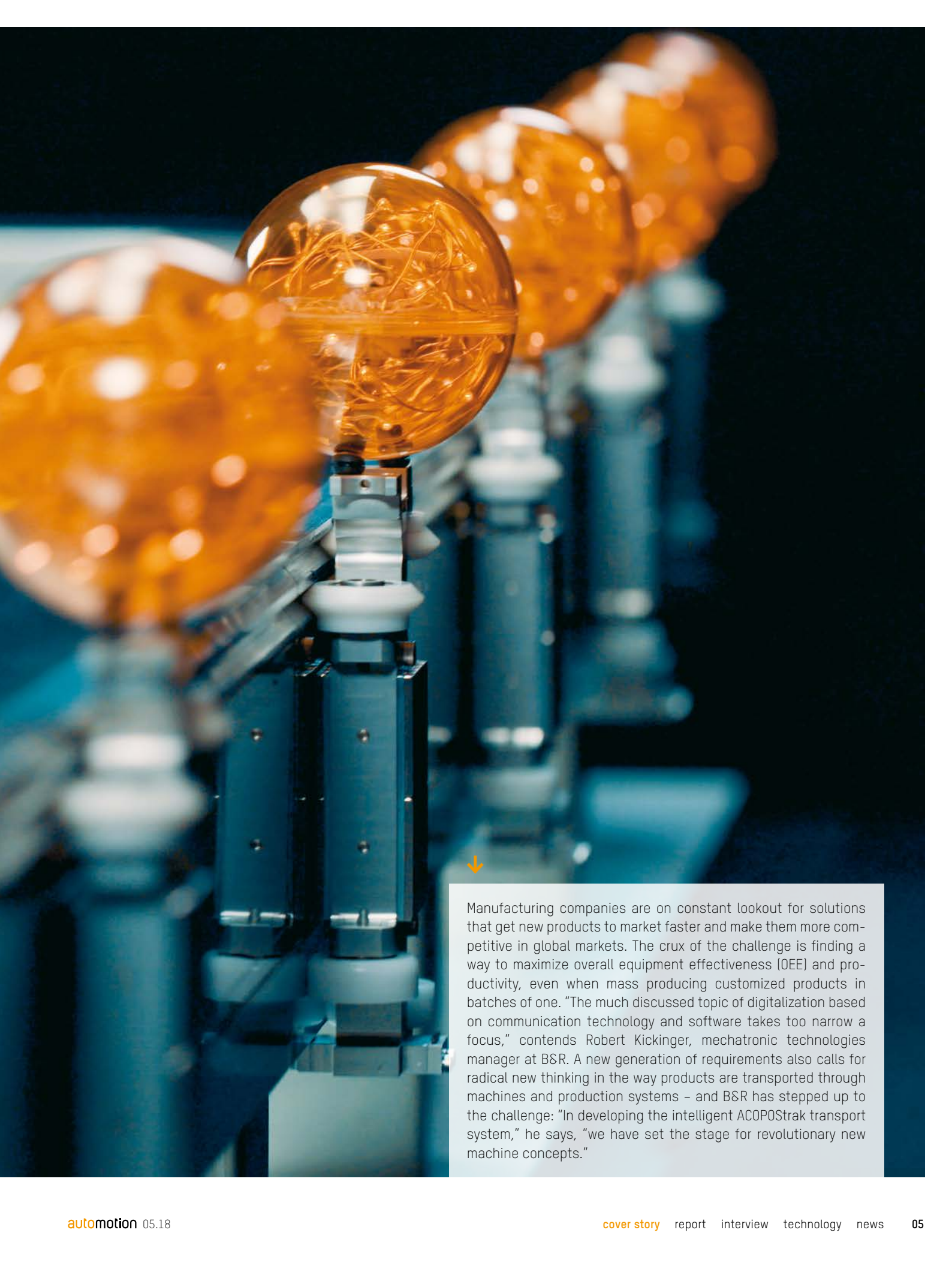
Intelligent transport system

# Digitalization on track

Digitalization alone is not enough to achieve true mass customization and batch-of-one production. Innovative approaches in mechanics and drive technology are also needed. It is exactly these kinds of approaches that make up the core of this new, intelligent transport system – whose revolutionary design enables adaptive manufacturing systems and promises a new era in flexible and efficient production.

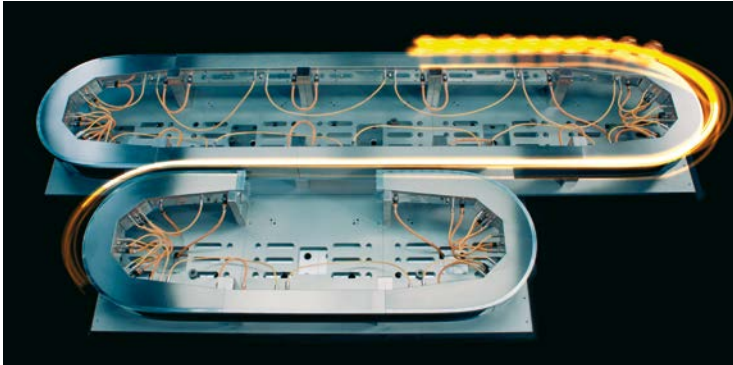
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The ACOPOStrak product is not available for sale into the United States of America until September 2018.

Photo: B&R

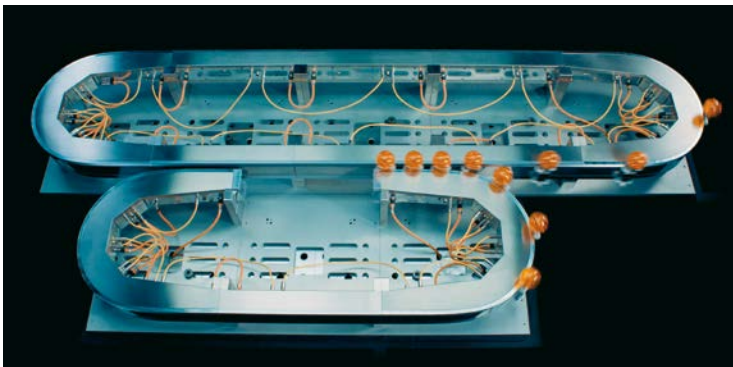


Manufacturing companies are on constant lookout for solutions that get new products to market faster and make them more competitive in global markets. The crux of the challenge is finding a way to maximize overall equipment effectiveness (OEE) and productivity, even when mass producing customized products in batches of one. "The much discussed topic of digitalization based on communication technology and software takes too narrow a focus," contends Robert Kicking, mechatronic technologies manager at BSR. A new generation of requirements also calls for radical new thinking in the way products are transported through machines and production systems – and BSR has stepped up to the challenge: "In developing the intelligent ACOPOStrak transport system," he says, "we have set the stage for revolutionary new machine concepts."





ACOPOStrak is capable of accelerating at over 5 g and achieves top speeds in excess of 4 meters per second.



Its purely electromagnetic diverters divide and merge product flows at full production speed.



To switch products, the operator simply places the wheels of a new shuttle on the guides of the pit lane, while production continues at full speed on the rest of the track.

### Diverter maximizes OEE

So, what is it that makes the intelligent transport system so uniquely suited for automating adaptive processes? "The diverter is – quite literally – a pivotal component of the system," explains Kickinger. "It is 100% electromagnetic and therefore entirely free of wear." Like a highway junction, the ACOPOStrak diverter allows product flows to diverge and converge. "The diverter allows the shuttles to switch tracks at full speed with no compromise in productivity," he emphasizes. Mass-produced items such as bottled beverages can be grouped on-the-fly into custom six-packs – three of one flavor, two of another and one of a third – without any changes to the hardware. The diverter also allows defective products to be sorted out as soon as they are identified, rather than continuing on to the end of the line as they would in a conventional system. This has a positive effect on overall productivity.

### Parallel processing

ACOPOStrak and its diverters also add a new dimension of flexibility for implementing parallel processing. The product flow can be divided, pass through multiple processing stations and then converge further down the line. This way, production speed is no longer throttled by the station with the slowest processing time. "The end customer can increase productivity without a corresponding increase in machine footprint," Kickinger explains. In other words, ACOPOStrak boosts output per square meter. "Ultimately, that means a higher ROI," he adds. When you build a machine or line using this intelligent transport system, you have the modularity and flexibility to add individual track segments and processing stations in response to changes in demand. The truly adaptive, scalable machines envisioned for the Industrial IoT become reality.

ACOPOStrak-based manufacturing systems are also exceptionally fault tolerant. If there is a problem with one valve in a bottling line, the bottles are simply no longer sent to that valve. The defective valve does not result in waste, which makes a big difference in the OEE quality factor.

### Zero-downtime changeover

The hot-swappable shuttles can be replaced tool-free and on-the-fly for unprecedented availability. When switching products, all the operator has to do is place the wheels of the new shuttle on the guides. The shuttles are held on the track purely by permanent magnets. Changeover and service can be made even more efficient by including a pit lane in the track layout. "One way of thinking of it is like the bench in ice hockey," says Kickinger. The



new shuttles are mounted in the pit lane and then channeled to the track's actual production lines via a diverter. In the same way, any shuttles that are no longer needed can simply be rerouted to the pit lane. "All of this takes place at full production speed," he emphasizes. ACOPOStrak's absolute design flexibility allows it to morph into all types of open and closed layouts by arranging the segments in different combinations on a grid. The core of the track system is a linear motor assembled from four types of modular segments: a straight segment, a 45° segment and two 22.5° segments – one curved to the right, the other to the left. "ACOPOStrak adapts perfectly to any production site," explains Kicking. "And at the same time, it opens up completely new machine designs that have never before been possible."

### Highly dynamic and flexible

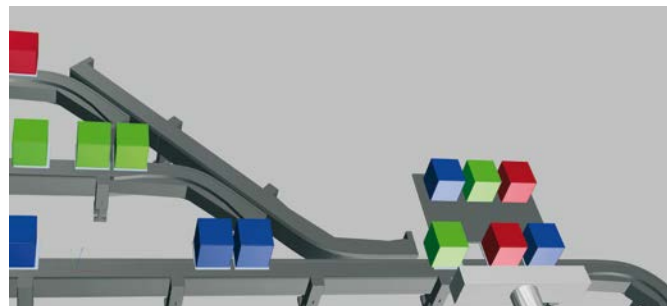
The intelligent transport system offers more than just flexibility, however: it is also unmatched in performance. The system is capable of 5 g acceleration and reaches top speeds in excess of 4 meters per second with a minimum product pitch of only 50 millimeters. "When you combine these performance numbers with the benefits of the diverters and the extreme design flexibility – it's a total package the market has never seen before," says the mechatronics expert, confident that the industry is the verge of a generational leap in productivity and accelerated ROI.

### Faster time to market

B&R provides an extensive range of software functionality to get ACOPOStrak up and running with minimal time and effort. The same application code can be executed in simulation or on the actual hardware with no limitations. "Developers can switch back and forth between simulation and real hardware as often as necessary," Kicking explains. This shortens development and commissioning times considerably. "That's an unbelievable advantage in terms of time to market." Developers also benefit from process-oriented programming. They simply describe the rules that define the product flow on the track, rather than having to program a multitude of axes and shuttles individually. Autonomous traffic control with integrated collision avoidance takes further work off the hands of developers.

### Mass customization

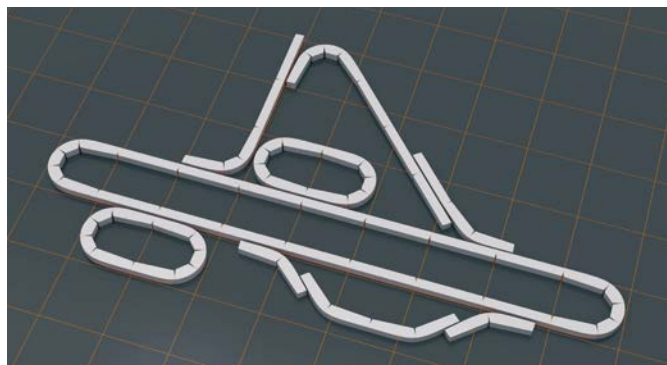
With ACOPOStrak, B&R has designed a solution that makes flexible, modular manufacturing systems highly profitable to operate. "Our system enables high overall equipment effectiveness, high return on investment and short time to market," summarizes Kicking. And with that, the industry is on the fast track to true mass customization.



Mass-produced items such as bottled beverages can be grouped into custom six-packs on the fly.

### Profitable production in batches of one

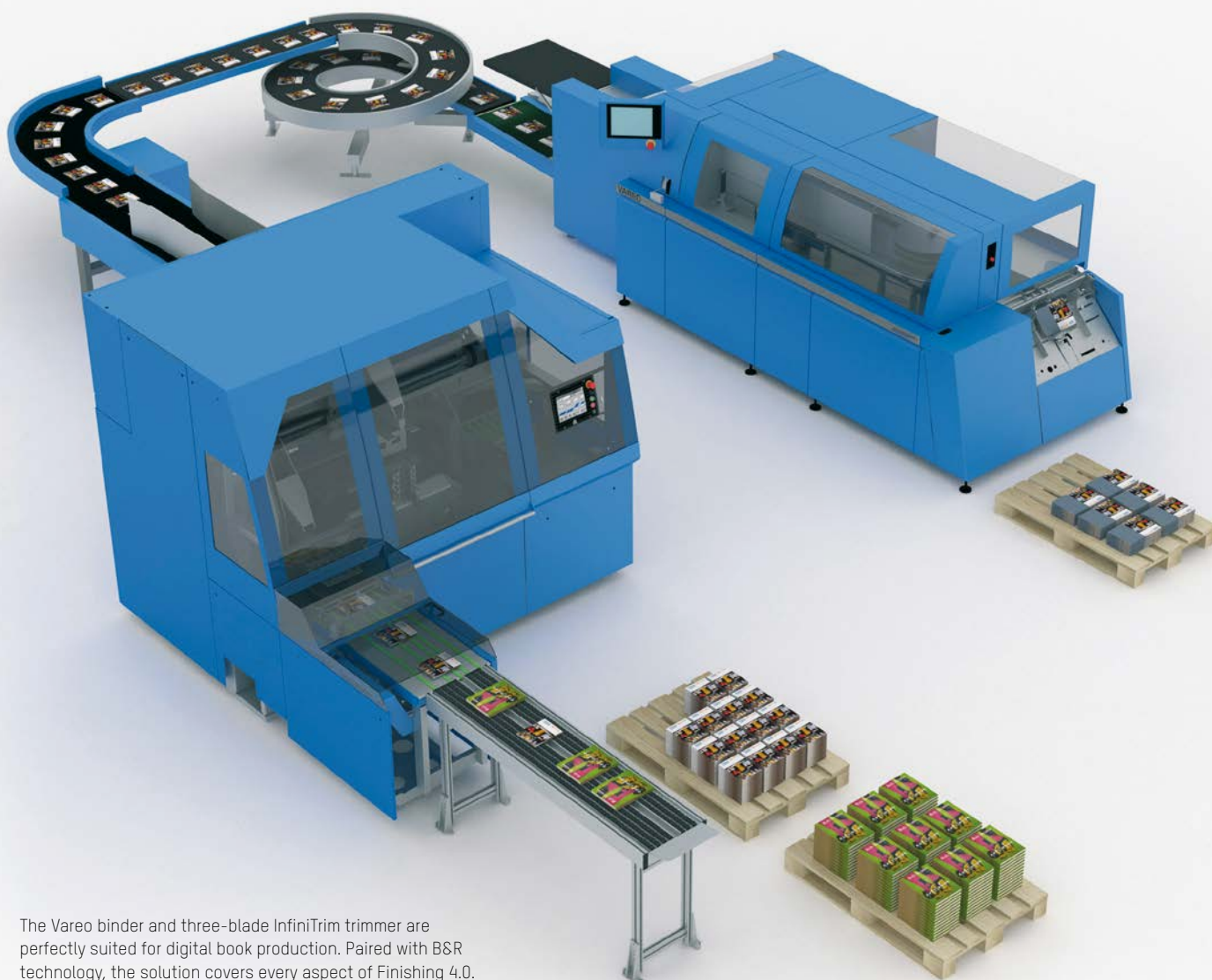
Demand for personalized products continues to increase, and consumers are willing to pay higher prices for them. Mass customization thus offers enticing economic returns. Implementing the new approach in a cost-effective way, however, remains a major challenge for most industry segments. That's because any increase in system flexibility is usually accompanied by a reduction in overall equipment effectiveness (OEE). The goal of mass customization is therefore to keep the three factors of OEE – availability, performance and quality – at a level consistent with what can be achieved in mass production. In addition, manufacturers seek to maximize return on investment (ROI) and to minimize their time to market (TTM) for new and improved products. This is the only way to make large-scale mass customization viable from an economic perspective. ←



ACOPOStrak's absolute design flexibility allows it to morph into all types of open and closed layouts by arranging the segments in different combinations on a grid.

Print finishing

# Finishing is just the beginning



The Vareo binder and three-blade InfiniTrim trimmer are perfectly suited for digital book production. Paired with B&R technology, the solution covers every aspect of Finishing 4.0.



It's not every day your hard work is recognized with prestigious accolades. That's why long-time B&R customer Müller Martini was so proud to receive the Swiss Industry 4.0 Award. The globally active Swiss machine builder was distinguished for its batch-of-one book production line, which embodies the company's philosophy of "Finishing 4.0". The solution addresses the increasing demand for small batches of customized, personalized printed products. Many of this line's functions are made possible by its seamless automation – for which the company has relied exclusively on B&R for over 25 years.



Gone are the days when print production could be considered a growth sector, and since 2008 the industry has undergone a profound structural upheaval. Successfully navigating the new landscape of customer requirements and consumer reading habits has required innovative adaptations. Müller Martini emerged from this transformation as a technological leader in the fields of offset and digital printing – a feat owed at least in part to automation solutions developed over the course of its 25-year collaboration with B&R.

#### **Finishing 4.0**

Müller Martini's Finishing 4.0 philosophy brings together a variety of innovations the company has developed over the past ten to fifteen years – a number of them in cooperation with B&R. "The key to Finishing 4.0 is that our data is fully utilized so that our processes are fully integrated," explains Christoph Gysin, Müller Martini's head of corporate development and standards. "Some of the innovations that have been made possible with B&R as our controls supplier include the ability to acquire and communicate machine data, as well as advanced diagnostic capabilities. Overall, it's the high degree of automation – with fast

motion axes, powerful industrial PCs, an efficient bus system and high-quality HMIs – that form the backbone of Finishing 4.0."

#### **Consistent down to batches of one**

The book production system recognized with the 2017 Swiss Industry 4.0 Award enables a completely hands-free workflow without any manual intervention or downtime for changover to produce books in very small print runs. Ultimately, that includes batches of one, as is frequently the case with photo books and other personalized products. The Connex workflow system developed by Müller Martini integrates every step in print production, from the print-ready PDF file to the finished book ready for shipping.

#### **Seamless flow to the finished product**

Connex starts by reading the book's information from a PDF and generating the necessary formatting and job files for the digital press. The custom book is then printed on a continuous web and processed into a book block. The Vareo binder then joins the book block with its cover, and then the product is trimmed to its final format in the InfiniTrim three-blade trimmer. Format, thickness and content can vary from book to



To ensure its ability to accommodate customer requests, Müller Martini builds all of its control panels in house.

book without the line ever requiring a single manual operation. Since the Connex workflow system is aware of what jobs are pending, it is able to make optimizations on its own. "It's Industry 4.0 in its purest form. We have moved past the theoretical talk into real-world solutions," says Gysin. "The jury of the Swiss Industry 4.0 Award took notice – but more importantly, so did our customers."

#### B&R – the right choice

On the search for an innovative and reliable controls partner, Müller Martini decided 25 years ago in favor of B&R. "At the time, they were just developing the System 2000," recalls Gysin. "From a technical standpoint, we were impressed by the modularity, breadth and completeness of their portfolio, as well as the programming capabilities. At a personal level, we shared similar corporate cultures, a readiness to accommodate and a passion for innovation. All these factors played a role in our decision to make B&R our automation partner." And it's a decision that Müller Martini stands behind to this day.

#### A well-rounded concept

From motion axes, controllers, industrial PCs and HMIs to development and diagnostics software, B&R automation solutions form the foundation of today's most advanced manufacturing systems. "Around 20 years ago, we worked with B&R to develop a comprehensive hardware/software concept – which we call the Müller Martini Automation Platform," explains Gysin. "This standardized platform continues to play a significant role

in the success of our most innovative projects." We worked together closely to establish software guidelines and define interfaces and various functions such as alarm management and I/O management. B&R's Automation Studio software also allows us to program and simulate very efficiently. We developed software libraries that make our programs both flexible and consistent. Of course, as B&R's products have evolved over the years, so has our platform. In the future, a number of the existing functions will be directly replaced by mapp Technology components."

#### Efficient solutions for the customer

For Müller Martini, the primary goal of Finishing 4.0 is to help print shops, newspaper publishers and book binders keep costs down and stay competitive while providing the increasingly individualized products their customers demand. "The cost pressure in the paper converting industry is enormous," emphasizes Gysin. "We give our customers the ability to personalize the content of their printed products without compromising in areas like seamless tracking and quality assurance. In line with the definition of Industry 4.0 – which applies equally to Finishing 4.0 – intelligently coordinated processes and systems make it possible to make highly individualized products with mass production efficiency. B&R sees the print industry as an Industry 4.0 pioneer – and are themselves a pioneer in their own field, having implemented Industry 4.0 at their plant in Eggelsberg. That's another important thing that our two companies have in common." ←







**Christoph Gysin**  
Head of Corporate Development & Standards,  
Müller Martini

"Our cooperation with BSR has been so successful for so many years because it is built on mutual trust, openness and corporate cultures that value stability, reliability, technological competence and long-term thinking."



Paired with the Connex LineControl system for data and process management, the SigmaLine enables efficient book production down to batches of one.





Interview

"The fruits of Industry 4.0 will not grow from isolated solutions."





Over the last decade, more than 2,000 employees of industrial organizations have taken advantage of the educational and vocational training opportunities at Germany's Technische Universität Darmstadt – where they learn about topics like Industry 4.0, digitalization and production efficiency and develop strategies for implementation. We spoke with research associates Jens Hambach and Andreas Wank and master's student Jonas Lauer to find out how Germany's SMEs are progressing in their digital transformation and where they still see room for improvement.



**What is it that your participants from industrial companies are hoping to learn here?**

**Hambach:** Everyone's talking about Industry 4.0 and digitalization, but there is still a great deal of uncertainty about what it all means in practice. Many companies are therefore turning to us for an overview of what their options are and to figure out where to take their first steps toward Industry 4.0 and digitalization.

**In your experience, what is the most commonly held misconception?**

**Hambach:** Many participants arrive thinking in buzzwords like cyber-physical systems, Internet of Things, machine learning and digital twins. These are high-profile concepts that pique people's interest and sensitize decision-makers to the issues at hand. In that way it is a positive thing – but, in the end, these are only instruments. If your entire strategy is aimed blindly at implementing specific technologies, it will generally not be effective. Our advice is to take a more methodical, benefits-based approach that starts with defining exactly what improvements can be made in your manufacturing process.

**Are Germany's SMEs lagging behind in Industry 4.0 implementation?**

**Wank:** Companies with under 250 employees really haven't made too much progress so far. Those with up to 2,000 employees have already invested substantially in digitalization, yet these investments have generally taken the form of isolated solutions dedicated to certain areas of the company. Now is the time to join these solutions together. Widening the focus from individual use cases to comprehensive solution sets makes it possible to leverage the benefits throughout the value stream. That is where we see the most room for improvement.

**What does that mean, exactly?**

**Hambach:** Companies have a variety of systems that they couldn't replace in the short term, even if they wanted to. From ERP systems to older equipment and numerous isolated sensors and instrumentation. In the course of our "Efficient Factory 4.0" project, we got to experience first hand the kinds of obstacles that can pop up when we tried to access data from a lathe that had been built in 2005. The controller didn't allow direct access to the machine data, and the manufacturer wanted €20,000 for the upgrade. For us, as would also be the case for many SMEs, this was simply not a viable solu-



**Jens Hambach**  
Research Associate, TU Darmstadt

"An Industry 4.0 strategy aimed blindly at implementing specific technologies will generally not be effective. Our advice is to take a more methodical approach that starts with defining specific improvements that can be made in your manufacturing process."

tion. So we took a step back and asked ourselves what data we really needed for the task at hand. Then we set about finding a solution that would allow us to read and process that data, and that could be linked with our other systems to form a comprehensive solution. That was when APROL showed up on our radar.

**And it turned out to be the solution you were looking for?**

**Wank:** Yes, it did. One of the reasons was its scalability. That enables us to implement and expand Industry 4.0 capabilities step by step. APROL is also equipped with a broad selection of standard interfaces, including OPC UA and ODBC. That makes it possible to integrate OT and IT systems quickly and consistently at all levels. At the same time, APROL allows us to implement our own interfaces or use open-source components and integrate them seamlessly. That's how we implemented a REST API in Python, for example, which APROL treats like one of its own components. The process control system's flexibility and extensive range of interfaces also make it easy to integrate into both new and existing plants.

**How do you get data out of a machine that – like the lathe you mentioned – doesn't have one of the supported standard interfaces?**

**Hambach:** That was a matter of a few simple modifications. For example, we added a small adapter between a sensor and the machine controller that grants us bidirectional access to a fill level sensor. That way we can read live measurements without having to go through the controller. Based on this, we were able to implement a function that notifies the machine operator whenever it is



necessary to refill the lubricant. We also tap into signals directly in the control cabinet. This is where another advantage of the B&R solution comes into play. Since the hardware and software is all from the same source and APROL is recognized automatically, there is no additional programming required.

**How does APROL help companies make real progress toward Industry 4.0 in areas like condition monitoring?**

**Lauer:** By serving as a platform for a wide range of applications, APROL makes it much easier to implement all sorts of Industry 4.0 capabilities. In the case of condition monitoring, the process control system offers a special function block that works optimally with a corresponding analog input module – the X20CP4810 – which executes the Fourier transform needed for vibration analysis.

**Can you give us an example of how that works?**

We used these features to digitalize an old band saw with a push-button controller and equip it with a condition monitoring system. The band saw can be made to simulate various conditions for demonstration purposes. Even with a low-cost condition monitoring solution that only reads the infeed pressure, it's possible to deduce the health of the saw blade and saw head. By equipping the machine with additional sensors, we're able to identify an even wider range of conditions with even greater precision. We hooked up the sensor data to a neural network that is able to recognize correlations that humans could hardly notice. With this data, APROL is able to do things like tell the ERP system which machine is ready for a new order and whether the current saw blade will be able to handle the job. As a local data node, we use a small controller from



**Jonas Lauer**  
Master's Student, TU Darmstadt

"By serving as a platform for a wide range of applications, APROL makes it much easier to implement all sorts of Industry 4.0 capabilities. With this approach, companies can generate added value – even on machines that play a relatively small role in value creation."

BSR's X20 system. Its integrated OPC UA interface makes it especially easy to connect to APROL and other higher-level systems. With this approach, companies can generate added value – even on machines that play a relatively small role in value creation.

**Does the neural network run within the APROL system?**

**Lauer:** So far, we have been building the neural networks with the MATLAB simulation tool. That is, we record all the sensor data with MATLAB, analyze it, and then process the results into a neural network – which in turn calculates the parameters that we need. In principle, however, it would also be possible to program a neural network in Python and then integrate it seamlessly into APROL, like the REST API we mentioned.

**APROL can be installed on virtual machines for cloud applications. Do you use this capability for added connectivity?**

**Wank:** Yes, we use APROL in a private cloud. There we have an encrypted SQL database that holds process-relevant data from the APROL traceability system. This database can be accessed by other systems, such as our shop floor management system, which is located in a public cloud so that interested companies can hook up to it as easily as possible. In the long term, we'd like to bring the management system back on-site in a private cloud on a dedicated computer. Then we'll be able to decide which data to keep in our own production system and which to send to a public cloud. ←



**Andreas Wank**  
Research Associate, TU Darmstadt

"APROL is equipped with a broad selection of standard interfaces, including OPC UA and ODBC. That makes it possible to integrate OT and IT systems quickly and consistently at all levels."



Industrial IoT

# Greater efficiency for machinery and equipment

Modern IIoT solutions can drastically improve the efficiency of plants and machinery.

Photo: BSR





To remain competitive in the long term, plant operators are under constant pressure to get more and more out of their equipment. Heralded as a silver bullet in this pursuit is the Industrial Internet of Things. Even in the short term, IIoT capabilities can deliver a substantial boost in efficiency. The IIoT also brings exciting opportunities for OEMs in the form of new business models.



Possibly the most decisive factor in the efficiency of plants and machinery is their availability. Every minute of downtime eats away at an operator's bottom line. "That's why it's so crucial to keep changeover times and unscheduled stoppages to a minimum," explains BSR Marketing Manager Stefan Schönegger. With the intelligent, connected machines that make up the Industrial Internet of Things, it's becoming possible to virtually eliminate unplanned downtime. One of the primary advantages is the ability to implement predictive maintenance strategies based on condition monitoring.

The relentless pursuit of efficiency has other ramifications as well, notes Schönegger: "More and more companies are offering their equipment in the form of integrated lines and processing centers." In some cases, these systems are even built to order for each customer. This kind of flexibility is only possible if the machines involved are able to interact with the ease of plug-and-play. "After all," says Schönegger, "seamless communication and exchange of data are fundamental requirements of both connected machinery and predictive maintenance."

Simply being able to collect, aggregate and analyze the operating data of a machine's electrical, mechanical and hydraulic components directly on site is enough to prevent many unplanned stoppages. "Beyond that, what you really want is a connection to the cloud," adds Schönegger. Cloud connectivity creates new opportunities and opens up new business models by giving OEMs the ability to read data from machines in the field and notify operators



B&R's Secure Remote Maintenance solution uses the latest in security technology, including VPNs and three-homed firewalls. These solutions make remote maintenance concepts easy to implement.

of impending problems. "It's a win-win situation," he continues: "The OEM gains an additional source of revenue, and the operator benefits from better machine availability."

### Connectivity on demand

It's up to OEMs to make it possible. "They have to provide their customers with tools for collecting and analyzing machine and process data, and they have to equip their machines with the necessary IT infrastructure," explains Schönegger. To do this, they need hardware that is able to collect and share data in sufficient quality. In other words: they need edge devices.

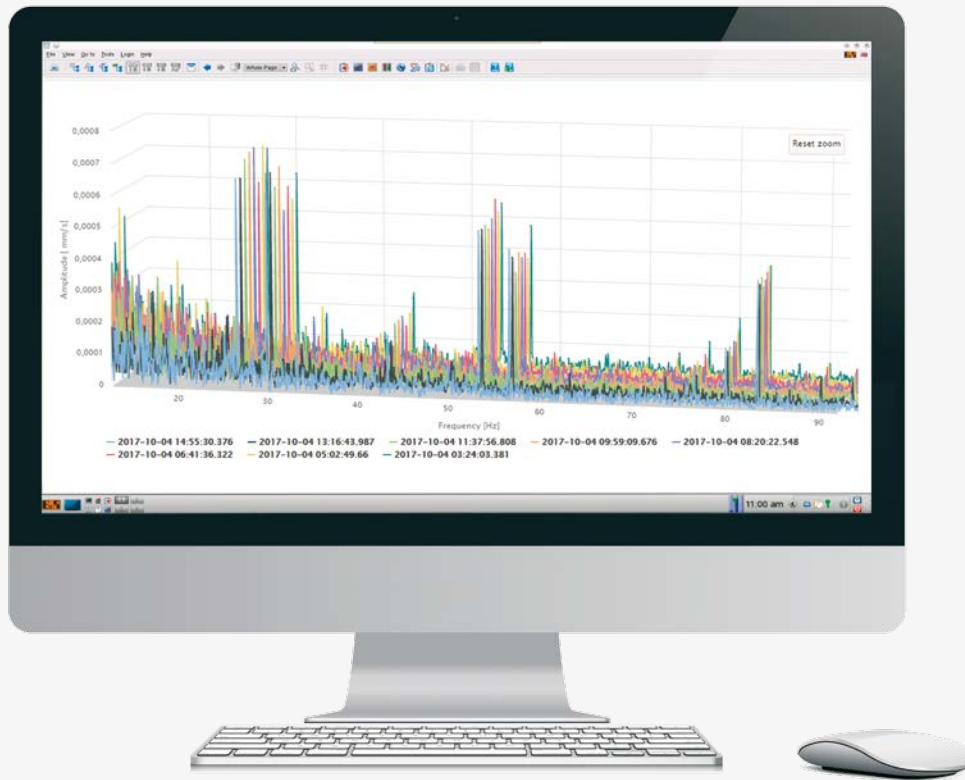
Addressing a common concern in this area, the IIoT expert assures OEMs: "You don't need a dedicated line or a constant connection to the Internet." All that's needed is a heartbeat sent at regular intervals containing information about the machine's health, such as hours of operation, temperature or speed. It is even possible to configure the edge components in such a way that they only send information when triggered by defined events – such as alarms or operating errors. Here, too, lies potential for new revenue streams, explains Schönegger: "If you notice a certain type of operator error occurring over and over, you can offer the customer targeted

training." IIoT solutions also enable more efficient remote maintenance strategies. Service technicians working for the OEM or their customer can connect with the machine and help on-site operators localize and correct the error. "Of course, whenever you talk about outside access to a machine, the topic of security becomes extremely important," emphasizes Schönegger. That's why B&R's Secure Remote Maintenance solution uses the latest in security technology, including VPNs (Virtual Private Networks) and three-homed firewalls.

### Data-driven service

Collecting data is an essential first step toward enjoying the benefits of the IIoT. "On its own, however, the data offers you no added value," notes Schönegger. It takes intelligent software algorithms to transform the raw data into useful information that can help optimize the efficiency of a manufacturing system. The good news is: OEMs don't have to develop these algorithms on their own. B&R provides them conveniently preprogrammed in the form of mapp Technology software components. With mapp components, a user can set up an energy monitoring or alarm system with just a few clicks of the mouse. Advanced software solutions like condition monitoring provide valuable information about the health of the





Vibration analysis offers insight into things like tool wear level, feed rate and cutting speed.

machine. Vibration analysis offers insight into things like tool wear level, feed rate and cutting speed. The machine operator can use this information directly or receive notification from the OEM when action is required.

### New business models

"The relationship between a machine builder and a machine operator can take on whole new dimensions," says Schönegger. It is even conceivable that what is sold is no longer the machine itself, but rather a certain quota of operating hours or an output quantity. In such a case, the operator no longer has to bother with servicing

the machine or replacing components. The OEM is able to keep an eye on the machine's status from afar. The operator is notified whenever service is required, but doesn't have to worry about anything - it's all handled by the OEM.

"There is one other important prerequisite for this type of setup to work," adds Schönegger: "The data being used must be of high quality." Even the most advanced monitoring solution is useless if it is based on incorrect or incorrectly evaluated data. B&R solutions offer extremely high sampling rates for digital drive technology, exceptionally fast control response times and advanced pre-processing right at the source of the data: in the I/O modules and edge components. "These are all critical factors in IIoT performance," says Schönegger.

### High availability in your product portfolio

The IIoT is a challenge OEMs need to face, even if the technology involved falls outside their traditional expertise. "That's exactly where we're able to step in with our hardware and software solutions," explains Schönegger. OEMs can get their machines IIoT-ready and offer their customers high availability with new business models for next-level service. ←



**Stefan Schönegger**  
Marketing Manager at B&R

"Intelligent, connected machines can reduce changeover times and unscheduled stoppages to a minimum."

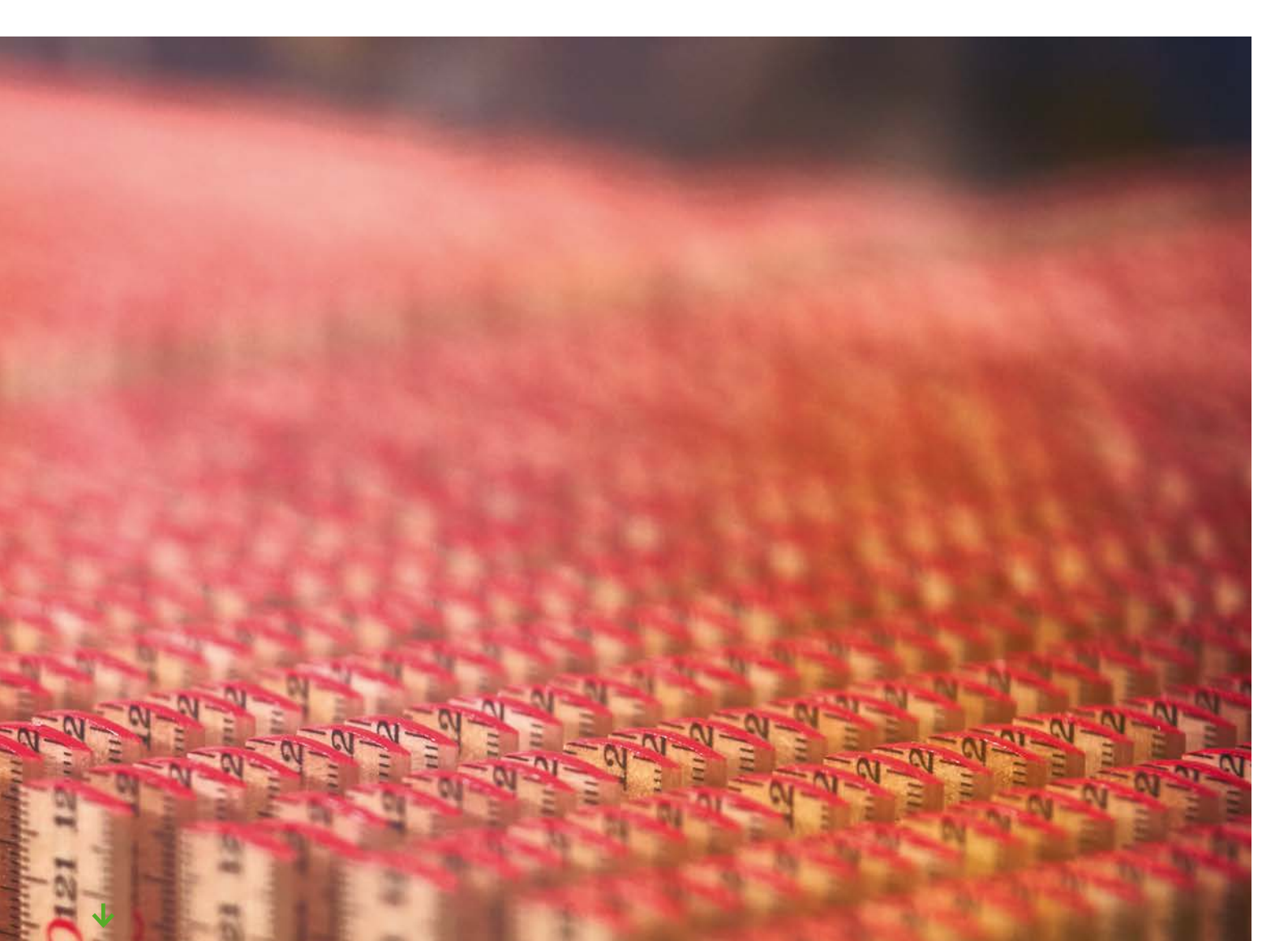
Hand tool production

# The exception that proves the rule

At the Hultafors factory in western Sweden, a century-old product tradition has been invigorated with state-of-the-art automation technology from B&R – reducing five machines to one in the process. The dramatic increase in productivity, along with quality materials and workmanship, has been key to the toolmaker's ability to buck trends and keep production local.

Photo: Stock





Patrik Tholinsson casually flips the folding rule between his fingers, effortlessly expanding it to its full length in under three seconds. "The bright red tips are our product's most important brand signal," notes the Hultafors mechanical engineer. The ruler's classic design – Swedish glass birch with a glossy lacquered finish and those signature red tips – has hardly changed throughout a hundred years of production. The product itself is strikingly simple: ten wooden segments held together by coated steel joints. Yet this hasn't kept Hultafors from retaining its position as the brand of choice for craftsmen in Sweden and all over Europe. Made to withstand 10,000 folds, the rule's quality lies in subtle details like the flexibility, strength and light weight of the materials.

#### Keeping production local

Still, the question arises: How can a low-tech product thrive in a country where high salaries have driven a constant shift toward more

high-tech products? "Tradition and brand awareness are two main reasons why our folding rule has remained a preferred tool for professional craftsmen," Tholinsson explains during a tour of his factory in the rural village of Hultafors, about an hour drive from Gothenburg. In addition to the quality materials and workmanship, Hultafors' ability to keep production local also relies on production efficiency. "Automation itself may not bring home simple manufacturing jobs like before," explains Automation Engineer Magnus Moldin, "but it makes us profitable enough to keep industrial production in Sweden."

#### The challenge of productivity

Hultafors is a division of the Hultafors Group, whose products include all types of hand tools, ladders and work-wear. Hultafors is unique among hand tool producers, having also developed the machinery used to make its tools. Manufacturing the equipment in-house gives Hultafors control over

the production process and handling of materials, including the wood, brass elements and cold-rolled steel rivets. Productivity requirements have risen steeply over the years. Until 2014, the folding rules were made by five separate units, each specializing in a particular version of the product with a given thickness and selection of materials. "When we started looking at how we could make the next leap in productivity," explains Moldin, "it became clear that a vital part of the solution would be to have a single production chain and a centralized control panel." Hultafors also wanted to replace mechanical and pneumatic technology with servo technology as much as possible. A modernized control system would need to import cam data and control multiple axes simultaneously. "In many ways, what we were building had to work like a packaging line, but with greater complexity and precision down to a thousandth of a millimeter," explains Moldin. The project itself



ACOPOSmulti from B&R provides a universal solution for any machine manufacturing automation task.

was a major challenge for Hultafors. It would take a year of machine design and another of construction before the equipment would begin production in the spring of 2016. Hultafors evaluated several machinery suppliers in search of the necessary control precision and dynamic movement. In the end, the choice fell on B&R and POWERLINK communication technology.

#### Total package with mutual benefits

According to the project group, the choice in favor of B&R was based on a combination of hard and soft values. "Other suppliers could have provided us with the hardware, but only B&R was able to offer us the support we needed all the way through design and implementation," says Tholinsson. "They deliver a total package of state-of-the-art automation technology, seamless support and expert co-development." Hultafors and B&R found mutual benefit in their collaboration. Hultafors engineers started the project with some important open questions, such as how many motors would be required. "B&R knew how to construct control systems, we knew how to construct production lines," clarifies Lars Ceder, production technician and key player at Hultafors for decades.

Hultafors chose to use an ACOPOSmulti servo drive system, which allowed them to scale and easily configure the equipment step-by-step as the project progressed. The number of motors increased gradually, and by using openSAFETY technology, the line's safety functions were ensured throughout the project.

#### All the elements of success

Completion of the new production line would rely on achievement of some clearly specified criteria. First, the entire solution would be developed in a single environ-

ment: B&R's Automation Studio. It would rely on the open, Ethernet-based POWERLINK real-time bus and feature integrated safety technology with openSAFETY. Both the hardware and software would be developed on-site and would draw on experience from the packaging industry. Application developers from B&R would provide on-site support and be accessible when key Hultafors personnel were absent. Cam automat and mapp software technology would be implemented with the assistance of B&R engineers. The B&R cam automat allows machine operators to change move-

ETHERNET

**POWERLINK**

open

**SAFETY**

**The advantages of POWERLINK, openSAFETY and Automation Studio**

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The line features a total of 52 B&R servo motors controlled by ACOPOSmulti drives, six stepper motors controlled by X20 modules and four asynchronous motors controlled by ACOPOSinverters.



The open Ethernet-based real-time POWERLINK bus connects the entire production line to the heart of its control system.




Hultafors' engineering trio in charge of the automation project, left to right: Patrik Tholinsson, Magnus Moldin and Lars Ceder.

ment profiles dynamically without requiring any new calculations on the controller. The line features a total of 52 B&R servo motors controlled by ACOPOSmulti drives, six stepper motors controlled by X20 modules and four asynchronous motors controlled by ACOPOSinverters. Nearly 60 pneumatic cylinders were implemented using two Festo CPX system valve terminals directly connected via POWERLINK. Fifteen emergency stops, ten safety doors and two light curtains were all connected and integrated via openSAFETY. The ACOPOSmulti units made it possible to mount the servo motors compactly and share energy between drives. This makes it possible to determine differences between the individual packets.

### More productive development

As one of the first implementations of B&R's mapp Technology software framework, the cooperation with Hultafors helped B&R optimize its new technology. Hultafors now plans to use mapp to simplify and accelerate software development in all future projects. The positive leaps that could be achieved with mapp Technology quickly became evident. Particular advantages included a function to enable and



**Patrik Tholinsson**  
**Mechanical Engineer, Hultafors**

"Other suppliers could have provided us with the hardware, but only B&R was able to offer us the support we needed all the way through design and implementation. They deliver a total package of state-of-the-art automation technology, seamless support and expert co-development."

disable synchronization of the virtual servo axes and cam automats that had replaced fixed mechanical cams. Restart times dropped and both the halting and start-up procedures were synchronized. Another advantage was better access to the machinery for service. Details about the production line's design and just how many folding rules it can produce per minute – these are secrets that Hultafors prefers to keep to itself. The productivity gains have certainly been substantial, and production that previously occupied five separate machines now only needs only one. Setup times have been reduced and flexibility has increased dramatically.

### The next step for Hultafors

According to Hultafors' engineers, the new control system places very few limits on what they can develop. Plans are underway for integrating an error handling system and for gradual implementation of Industrial IoT technology. Thanks to the flexible new control system, Hultafors is set to start production of a longer, 2.4-meter folding rule as well as new equipment for producing longer measuring tapes manufactured at another Hultafors Group site. "When a supplier is able to act as a full partner on the production site" concludes Moldin, "developing new technology is a much smoother and more reliable process." ←

# Servo motors with maximum torque density



New lengths available for size 5 motors round off the 8LS line of servo motors with powerful, dynamic performance.

## Dynamic powerhouse added to B&R's servo motor lineup



B&R has taken the next step in development of its 8LS servo motors. Three newly designed size 5 motors in lengths A, B and C fill out the mid-range of the 8LS product line. Compared to their predecessors, they offer more compact dimensions and improved thermal design.

### High dynamics and strong performance

The new 8LS servo motors are highly dynamic and offer a high torque-overload ratio. They are perfectly suited for applications

such as plastics processing, printing presses and servo pumps. With a flange size of 142 mm, the new motors deliver excellent torque density. Customers profit from more power with smaller space requirements. They can be combined with any of B&R's many gearbox options and shipped as pre-assembled motor-gearbox combinations.

### Safety included

All motors from the 8LS series are offered with an optional digital encoder and optional safety functions. For the majority of speed variants, motors up to size 7 are also available with a single-cable solution that combines the cables for the motor and encoder. This reduces cabling to a minimum and substantially reduces installation costs. ←



# New T50 web terminal sizes



The Power Panel T50 features a projected capacitive multi-touch screen, perfect for creating modern and user-friendly HMI applications.

## B&R further expands Power Panel series



B&R is expanding the Power Panel T50 series with two new sizes. There are now five different sizes to choose from, with diagonals ranging from 5 to 15.6". All T50 models have a glass touch screen and are capable of handling multi-touch gestures.

### Powerful hardware

These HMI terminals are compact, easy to configure and ideally suited for premium machine designs. Gestures such as zoom or swipe

provide an intuitive user experience. With powerful hardware that meets the high demands of web-based HMI, the Power Panel T50 can be used to implement either web-based or VNC-based applications.

### Easy configuration

The T-Series Power Panels are delivered with an integrated service page. This service page opens without having to be installed and makes it possible to customize settings such as IP address, DHCP server or screen saver directly on the device.

### Fast cabling

The Power Panel T50 is equipped with a Gigabit Ethernet interface. Power Panel T50 units are available with an optional integrated switch that allows simple daisy-chain cabling. ←

# Reliable giants

A man with a shovel would toil for weeks to move what the high-capacity bucket of a mining excavator can carry away in a single load. Yet, the more earth these massive machines move with each bite, the faster each second of unscheduled maintenance eats away at the bottom line – which is why mining companies go to such great expense to keep their giants healthy. The cost of achieving this crucial reliability can be reduced considerably through intelligent maintenance.





Far from the nearest civilization, towering high above their human masters, gigantic monsters take huge bites out of the rocky landscape. The world's largest mining excavator is 24 meters long, 8.8 meters wide, 11 meters high and weighs in at 800,000 kilograms. Seated comfortably in the cab a dizzying 10 meters off the ground, the driver works the joysticks that control an enormous 47-cubic-meter bucket. In just 20 seconds, the colossal machine moves 80 tons of material. "When such a huge excavator goes down, not only does the operator suffer costly losses in productivity, but the ramifications can be felt throughout the entire logistics chain," explains Stefan Taxer, BSR's product manager for mobile automation.

Preventing unexpected downtime is therefore a top priority. To this end, rotating com-

ponents like hydraulic pumps, motors and gearboxes are traditionally over-engineered or replaced at conservatively short intervals. To keep any downtime that does occur as brief as possible, mining companies keep a sizable stock of replacement parts close at hand. "What all of these solutions have in common is that they incur additional costs," Taxer points out. These costs can be reduced by applying modern approaches to analytics and maintenance.

#### Forecasting faults

As time takes its toll on rotating machine components, even an untrained ear can often hear the difference. "It's relatively easy to tell when your car has a defective wheel bearing because of the distinct noise it makes," says Taxer. Mining excavators are so noisy, however, that it is impossible to distinguish any audible change.

"This is where vibration-based condition monitoring comes in handy."

After all, the audible noise is nothing more than vibrations at a certain frequency. A properly configured condition monitoring system will recognize a spike in vibration amplitude in a specific frequency range as the signature of an impending fault. The height of the spike denotes the severity of the damage, indicating how soon a given part should be replaced.

#### Putting vibration data to good use

"Evaluating vibration data relies on two critical elements," notes Taxer. On the one hand, you need high-performance hardware that can read the data at a sufficiently high frequency. On the other, you need intelligent software able to detect the tiniest deviations in a huge volume of data.



B&R's modular X90 control system is available with an optional circuit board for implementing condition monitoring. Vibration sensors can be connected directly and their data evaluated on the controller.

"Our modular X90 control and I/O system offers the perfect hardware platform," says Taxer. The heart of the system is the X90 controller with a powerful ARM processor and up to 48 multifunction I/O channels. The modular controller can be equipped with optional I/Os, interfaces or circuit boards – such as the one for condition monitoring. "Paired with our mapp software components, this results in a very high-performance system that monitors machine health and informs operators in time to take action," says Taxer. "The mapp components are quick to configure and communicate with each other automatically – reducing the amount of actual programming to a minimum."

#### **You've got mail... from your machine**

One example of how mapp components communicate is the interaction between the alarm and notification systems using mapp Alarm and mapp Tweet. "You can easily link these components so that, whenever an alarm occurs, the service technician will receive an email or text message," says Taxer. This message can inform the technician that a certain bearing is worn and should be replaced within a certain time span. "As easy as the alarm system is to set up, the most exciting part is the impact it can have on the overall maintenance strategy," says Taxer, referring to the enormous potential for savings.

Condition-based maintenance streamlines spare parts logistics and eliminates the need to replace perfectly healthy components long before the end of their service life.

It even becomes possible to share certain condition monitoring data with the machine builder. "If a manufacturer is able to track the health of their machines, they can drastically reduce the probability of failure," notes Taxer. This, of course, is also in the best interest of the operator.

Builders of mobile equipment can also use selected data to optimize their designs, and are able to pursue new business models such as equipment monitoring as a service. In this case, the operator is relieved of the fleet maintenance headache and is simply informed when a replacement part will be delivered and installed.

#### **Win-win situation**

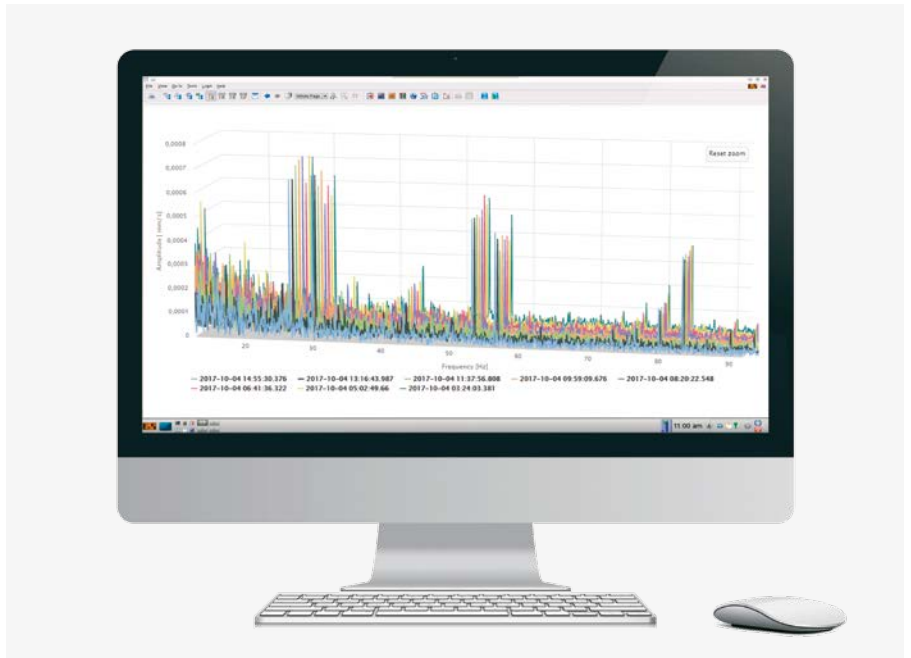
This brings Taxer to yet another advantage: "It's no longer necessary to over-engineer so many components." A fact which, once again, benefits both sides: the manufacturer saves production costs, and the operator pays less for the machine. Since the X90 controller can be connected to exist-



**Stefan Taxer**  
Product Manager - Mobile Automation, B&R

"Condition monitoring offers substantial cost benefits for both builders and operators of mobile equipment."

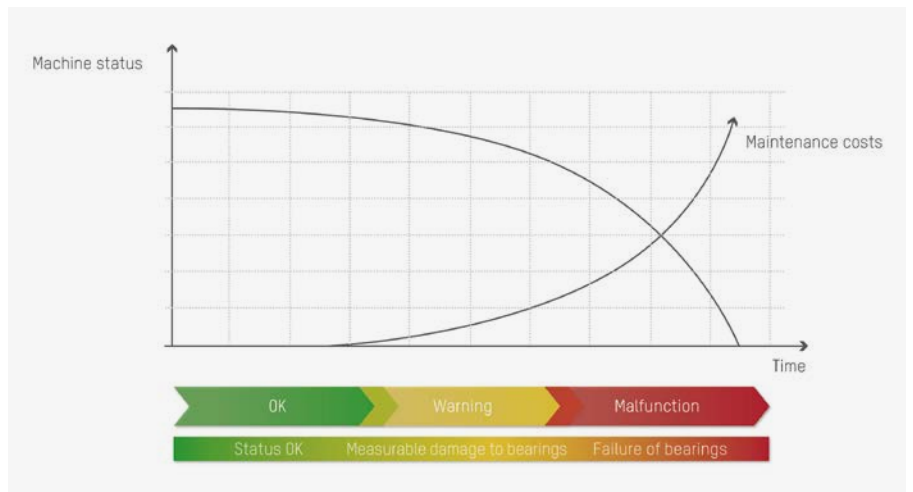




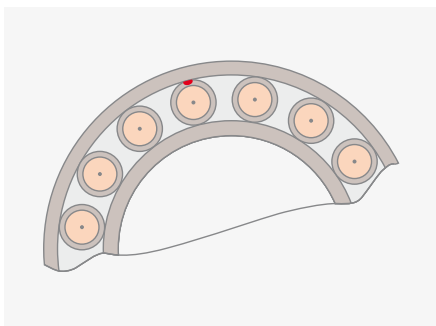
Vibration analysis data helps machine operators identify the best time to replace specific components.

ing CAN architectures, it is easy equip an existing fleet with condition monitoring. "It becomes possible to move step-by-step toward a modern real-time bus system that is able to handle the volume of data being generated by today's machines."

Conventional strategies for preventing unexpected failure of mining excavators are costly and resource-intensive. With BSR's X90 system and condition monitoring technology, both manufacturers and operators of mobile equipment can generate added value with solutions that make their steel giants more reliable. ←



The longer the damage goes undetected, the higher the resulting maintenance costs.



Even the slightest defect on a bearing can be detected early through vibration analysis.

### Applied experience

B&R has nearly 40 years of experience creating automation solutions and driving innovations in a wide variety of industries and has successfully implemented high-performance Industrial Ethernet protocols like POWERLINK in many different sectors. Today's mobile equipment can leverage this valuable experience to solve some of its most critical challenges. For manufacturers of mobile machinery, the X90 mobile control system is a future-proof investment in the reliability and profitability of their equipment.

# Reliability counts

Small, smaller, smallest. In recent years, that has been the trend in the world of gasoline and diesel motors for private cars and delivery vans. While people continue to crave horsepower, they are also increasingly environmentally conscious, and regulations for fuel efficiency and CO<sub>2</sub> emissions are growing ever more stringent. To satisfy these conflicting demands, Mitsubishi Turbocharger & Engine Europe (MTEE) equips many gasoline and diesel motors with turbochargers. In fact, the company has an assembly line for nearly every major European automaker. To store the 5 terabytes of data generated on these lines every day, MTEE relies on B&R Automation PCs and Automation Panel HMIs.



A member of Japan's Mitsubishi Heavy Industries, Mitsubishi Turbocharger & Engine Europe (MTEE) builds approximately 3 million turbochargers each year at its 5 factories in the Dutch city of Almere. With more than 750 employees, MTEE designs, manufactures and tests turbochargers for various types of engines for almost every European car manufacturer – from Ford, Fiat, BMW and Volkswagen to Bentley, Bugatti, Porsche and McLaren.

## Lean assembly

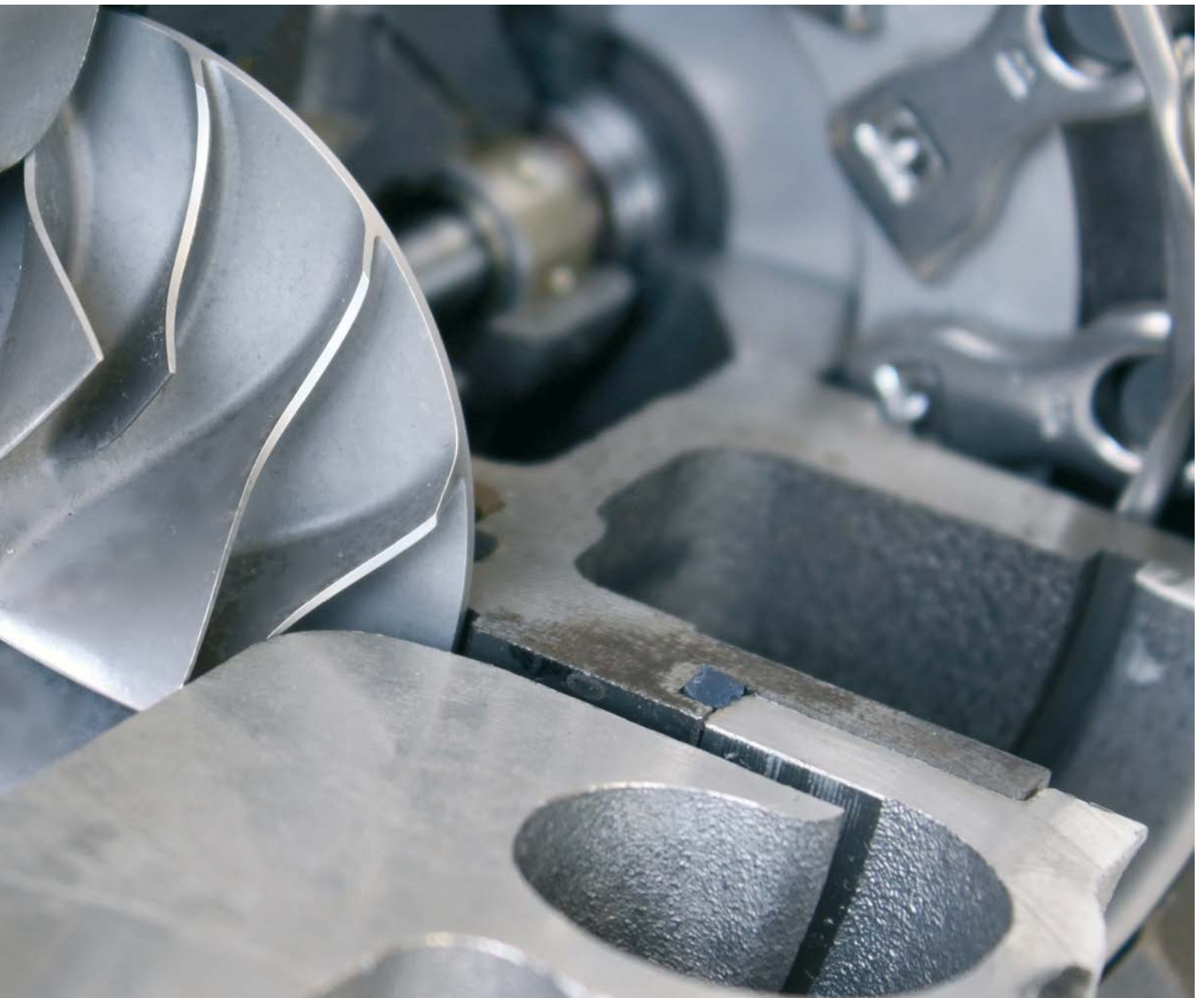
MTEE currently operates 31 assembly lines in Almere, including 3 turbo rotor lines, 3 compressor wheel lines and 2 completely robotic cartridge lines. Each year, 2 to 3 new lines are added to keep pace with the arrival of new models of private cars on the Europe-

an market. Says Ruben Roodenburg, team leader for industrial automation in Mitsubishi's production engineering department: "When adding a new line, we strive for the lowest possible total cost of ownership, reusing existing hardware wherever possible when adding a new line. In the framework of lean manufacturing, we also aim for the lowest possible rejection rate, continuously examining whether the process can be designed in a smarter way, accelerated or completed with less waste."

## Efficient logistics

When it constructed factory 5 in 2009, MTEE applied lean manufacturing concepts to the design of the operational section (input to output), examining ways to reduce cycle times and streamline





access routes. Shortly afterwards, factory 4 was renovated based on the improved design of factory 5. The more efficient layout saved enough floor space to add new aftermarket assembly lines. A corridor was also constructed between the logistics center and the assembly lines in factories 4 and 5. Rather than transport pallets one at a time through an outdoor area with a forklift, they are now carried 12 at a time on a train running directly from the logistics center to the two halls – quite a logistical improvement.

#### **Operation pyramid**

The assembly lines have centralized control, while the turbo, compressor wheel and cartridge lines still have decentralized control. In all cases, there are three levels of operation: the MES level, the

operational level and the machine level. The entire recipe is prepared using a web-based interface at the MES level before an assembly line is started. Subsequently, at the operational level, a shop order with part number is created for the recipe. As soon as the order is confirmed, all the data is automatically sent to the machine level, so that the machines can adjust themselves automatically. Recipes are changed approximately two to three times per day. The operational and machine levels feature dozens of Automation PCs. On the operational level, these PCs run SCADA systems and the SQL database, while on the machine level they are used to carry out function tests. "B&R's Automation PCs are installed on 95% of all the lines, sometimes in combination with single-touch or multi-touch Automation Panels,"



On the operational level, these PCs run SCADA systems and the SQL database, while on the machine level they are used to carry out function tests.



B&R's Automation PCs are installed on 95% of all the lines, sometimes in combination with single-touch or multi-touch Automation Panels.

says B&R sales engineer Wico Reineman. When a box with 32, 46 or 48 turbochargers is ready in a line and can be sent to the logistics center, the data for that box is written to a large database at the MES level.

### Massive data storage

"Every day, an enormous amount of data must be written to disk for each assembly line," explains Roodenburg. "To meet traceability requirements, we need to be able to quickly retrieve this data even decades later. The PCs we previously used were not up to the task, and we had to replace the valuable hard disks every six months." A customer advised MTEE to look into the possibilities of B&R's Automation PC, and after examining the specifications, MTEE conducted a pilot implementation in 2011. B&R's PCs did not report errors during production and cause unnecessary standstills – sufficient reason for MTEE to make the switch.

### APC with Windows

"Every B&R Automation PC at Mitsubishi has a 64-bit Windows 7 operating system, in accordance with the customer's specifications," says Reineman. "The distinctive feature is the high-quality hard disks that are used, which have an almost infinite number of write operations. Unlike other hard disks, the storage capacity of our hard disks is fully utilized. Because the data is written in a dif-

ferent way than with normal PC systems, our systems last longer and have a substantially longer mean time between failure (MTBF)."

### RAID1 system

The C: drive of the Automation PC 910 is a 60 GB SSD, and the SQL database is on the D: drive. The entire system is set up as a RAID1 system; the two disks are copies of each other. If one of them breaks down, production can continue unaffected. MTEE deliberately chose the most robust PC configuration offered by B&R. If a new Automation PC is ever needed, its replacement can be quickly configured via the WDS server. Reineman adds: "Any factory in

### Ruben Roodenburg

Team leader industrial automation, Mitsubishi

"Every day, an enormous amount of data must be written to disk for each assembly line. The PCs we previously used were not up to the task, and we had to replace the valuable hard disks every six months."





The plant of Mitsubishi Turbocharger & Engine Europe (MTEE) in the Netherlands.

**Wico Reineman**  
Sales Engineer, B&R

"Unlike other hard disks, the storage capacity of our hard disks is fully utilized. Because the data is written in a different way than with normal PC systems, our systems last longer and have a substantially longer mean time between failure."

the world that works for MTEE can order the same PC configuration, completely tested and approved." The machine builders can decide themselves whether they want to add a multi-touch or single-touch B&R Automation Panel to the order. The multi-touch panel is convenient when working with graphical objects, such as function tests, because of the convenient swipe options, zoom and scroll functionality and two-hand operation. For SCADA applications a single-touch panel is sufficient. In 2007, MTEE began data collection for all its assembly lines. A backup is made of all 120 PCs every four hours, minimizing the amount of data lost in a

worst-case scenario. These backups are written to the redundant RAID1 system. In addition, a full backup is made every day.

**Cold room**

A year ago, Mitsubishi built a cooled server room in Almere to store data from all the Automation PCs of its various lines. All the PCs in the server room are virtualized, and the room also has an SQL database. Mirrored systems are set up in data centers in Enschede and Zwolle in case of emergencies.

MTEE stores the data for every manufactured product for 20 years – soon to be extended to 25 years. Besides this data center, MTEE also has a web portal. Customers can log in and enter their serial number and part number to access to all the relevant product details, inspection values, torque values and vision-inspection data from anywhere in the world.

**Fully automated future**

Since MTEE commenced production in Almere, they have manufactured 23.5 million turbochargers. "Eighty percent of this volume has been realized in the past 6 to 7 years – in other words, since we began the automation process," says Roodenburg. "Now, MTEE is busy redesigning the turbo rotor lines for centralized control. Step by step, we are on our way to unmanned assembly." ←



Printing and converting

# Short runs, shorter learning curve



The new Fusion C flexo press was developed to meet the demands of mid-web and shorter-length runs that require more efficient changeovers and setups with high repeatability and maximum uptime.

Photo: PNC





Converting companies face financial pressures across the board and have difficulty finding skilled employees. For press manufacturers like PCMC, it is therefore vital to incorporate technologies that allow repeatable and reliable changeovers, minimized setup and material waste, and efficient ink management and energy usage. Together with B&R, PCMC developed an innovative flexographic press that offers the flexibility, sustainability and ease-of-use their customers depend on.



Consumer goods are being offered in an increasing range of varieties and flavors within brand families. In turn, all segments of the printing market report that production runs are getting shorter and order frequency is increasing. More than ever, a top priority for operators of printing machinery is the ability to provide a full range of automated converting solutions.

These demands are compounded by current trends in the marketing industry toward regional and personalized promotional campaigns. Companies are personalizing their product labels and packaging to target specific groups based on geographic area, interests and demographics.

#### **Flexible, efficient and easy to use**

Headquartered in Green Bay, Wisconsin, Paper Converting Machine Company (PCMC) is a worldwide leader in its industry with nearly a century of expertise in tissue converting, packaging, flexographic printing and nonwovens technology. Using advanced control and operation technology from B&R, they arrived at a reliable, holistic solution that perfectly meets all these needs: the Fusion C.

"PCMC is well known as the only North America-based flexographic printing OEM," explains PCMC engineer Todd Lemke. "The launch of



Using advanced control and operation technology from B&R, PCMC arrived at a reliable, holistic solution that perfectly meets all these needs: the Fusion C.

the Fusion C in August 2016 was one of the greatest developments in the company's history." The new flexo press was developed to meet the demands of mid-web and shorter-length runs that require more efficient changeovers and setups with high repeatability and maximum uptime.

"The Fusion C is loaded with fast make-ready and waste-saving features, which the operator accesses through the B&R Panel PC," says Lemke. "It has a smaller footprint and fewer parts, saving space and cost. Its accessibility and ease of use make the Fusion C

a unique offering in the market." Used primarily for food and beverage packaging, the Fusion C is capable of flexographic printing with a tight tolerance on a variety of substrates and with a variety of ink types.

#### Full functionality at operator's fingertips

The Fusion C helps printers meet the increasing demands of production schedules with features such as zero-speed initial impression and registration setting, ink color and viscosity management, automatic ink/deck wash-up, central impression drum cleaning, energy-efficient and responsive drying and closed-loop camera-based impression and registration setting. The enclosed design of the ink doctor chamber improves ink usage efficiency and allows for more automation along with greater ease of use due to toolless on- or off-press preparation.

The touch screen operator station – a customized B&R Panel PC – places these many press features and functions at the operator's fingertips in a user-friendly 16x9 format. The swing-arm-mounted HMI unit with a built-in PC has been highly customized to meet the requirements of the machine and application. For example, the controller communicates with a networked rotary encoder via B&R's X2X extended backplane technology for fast responses to print offset changes made at the operator station. It also includes



**Todd Lemke**  
Engineer, PCMC

"B&R is an innovative company that is able to develop components to meet the needs of their customers. More importantly, they are able to guarantee the availability of these designs for an extended period of time – which is very attractive to an OEM in a world of ever-changing technology."

Photos: PCMC





"The Fusion C is loaded with fast make-ready and waste-saving features, which the operator accesses through the B&R Panel PC," says Tom Lemke, a PCMC engineer.



PCMC and B&R co-developed solutions – such as networked illuminated ring keys – which simplify the machine’s control topology by replacing hardwired components such as pushbuttons.

an RFID reader for access control and remotely mounted X2X-networked B&R illuminated ring keys, which were custom-developed for the Class I Div 2 environment presented by solvent-based inks.

#### Ease of use for a short learning curve

Trends in the industry required operational features that are user-friendly and intuitive, so that new operators are able to rapidly gain the knowledge they need to achieve successful printing results. To meet this need, PCMC and B&R co-developed solutions such as the networked illuminated ring keys – which simplify the machine’s control topology by replacing hardwired components such as pushbuttons.

B&R bus couplers also proved to be a reliable, low-cost solution for integrating different protocols into a common control platform. A B&R EtherNet/IP bus controller, for example, communicates with a B&R CAN interface module, which captures information about ink viscosity from a viscosity sensor in the ink chamber.

Todd Lemke concludes: "B&R is an innovative company that is able to develop components to meet the needs of their customers. More importantly, they are able to guarantee the availability of these designs for an extended period of time – which is very attractive to an OEM in a world of ever-changing technology." ←



Process optimization

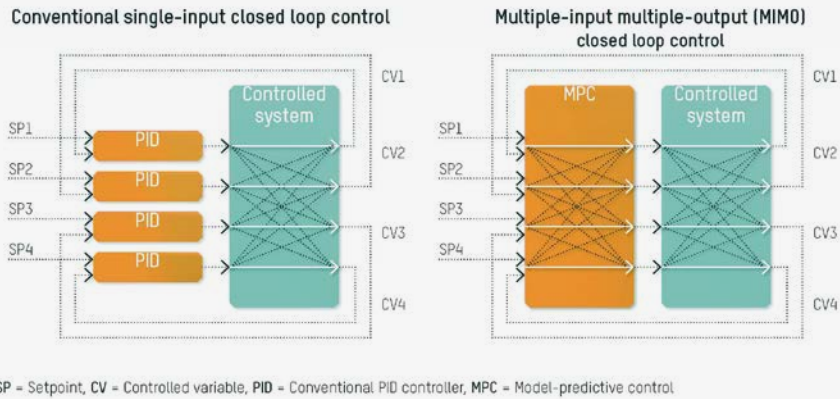
# Control loops tuned for optimum performance

Once they are up and running, machines and plants require continuous care to maintain optimal performance. Many PID controllers, however, fall victim to a “set it and forget it” approach. The task of constantly checking and adjusting them is simply too time consuming. The situation is much different if you have ready-made software components that allow you to monitor the performance of control loops and make targeted adjustments when necessary.





To provide the necessary redundancy, many plants have multiple similar lines operating side-by-side. Though they may be producing the same products, these lines are generally composed of machines and components from different suppliers. The foremost concern of the plant operator, however, is output alone. When similar lines start showing significant differences in productivity, the search is on to find out why. "What is too often over-looked in this search," says Martin Reichinger, B&R's business manager for process automation, "are the individual machines that make up the lines."



In contrast to conventional single-variable controllers, multi-variable control takes interdependencies into account.

This has a lot to do with the fact that the ability to analyze data at the level of individual machines is a relatively recent development. Today's technologies, however, provide entirely new levels of insight into the machines' inner workings. "With an edge controller," says Reichinger, "you now have easy access to every control loop and every asset – whether it's a heat exchanger or a centrifugal pump – and you can be constantly optimizing their performance."

### It's all relative

When setting PID parameters to regulate things like pressure or temperature, engineers have traditionally relied on educated guesses and rules of thumb. "As a result, you have two-thirds of all control loops that, although stable, are not tuned optimally," says Reichinger. That leaves substantial room for improvement. "But, if all you have to work with are the values of a single PID controller, you'll have a hard time deducing which ones are causing trouble," notes the automation specialist. If you're able to compare two similar machines or systems, however, it's much easier – even without any knowledge about the specific process involved.

Evaluation methods based on this type of comparison are known as control performance monitoring (CPM). A CPM module is included in B&R's "advanced process control (APC)" solution. APROL APC can be used as a standalone solution or as an integrated component of the B&R APROL automation platform. The CPM control module can also be connected to external systems via

OPC UA, making it possible to compare data from different sites.

### Metrics for evaluating PID loops

B&R's CPM solution makes it possible to evaluate PID loops based on a variety of metrics, and to optimize their settings using efficient tuning methods. One such method is asset monitoring, which is able to identify fouling of heat exchangers or cavitation in centrifugal pumps.

Reichinger's team has developed a number of helpful reporting tools for its CPM solution, including a loop report, which focuses on a single PID loop, and a plant report, which provides overview of multiple loops or an entire plant. "Looking at these reports, you can see which parameters stand out," says Reichinger. "They provide a clear statement about the quality of your PID settings." The CPM solution also shows how many times the operator had to intervene, and how often the control loop reached its limit values.

### Optimized with minimal intervention

Once the potential for optimization has been identified using CPM, B&R's APC library offers a number of tuning blocks that apply different methods to automatically determine how the control loop works and calculate the optimal PID parameters. "Traditionally, the user has had to play around with different I or D values and see what happens," explains Reichinger, "but with our blocks, that's no longer necessary." One of the blocks allows tuning based on the finite-frequency method. "The advantage of

this method is that you're able to optimize the controller using very small excitation signals," notes Reichinger. Even an amplitude of  $\pm 0.5\%$  for modulation is enough to get a well-tuned PID controller. Different production processes require different types of control loop. There are split-range loops, alternating loops and many more. "Developing these controllers from scratch is a lot of work," says Reichinger. B&R has simplified the process by developing a variety of control functions that work as add-ons to a classic PID controller. The gain scheduling function, for example, can be used to implement a controller that automatically adjusts the PID parameters based on the operating point. These control functions are listed in the APC library along with the tuning blocks.

Unlike the PID controller, MPC allows the user to define limits that are not permitted to be crossed. But how is that possible? "MPC uses a model of the process to continuously calculate how the values will progress in the future," explains Reichinger. This enables the controller to determine early on when a value is in danger of violating its limits and make the necessary corrections before a violation occurs. "Stop-pages can be almost entirely eliminated." Effectively ensuring that the limits are not exceeded also makes it possible to run the process closer to its operating limits.

### Greater efficiency through optimized control loops

Modern technology makes it easy to continuously monitor and adapt the perfor-



### Flexible solution package

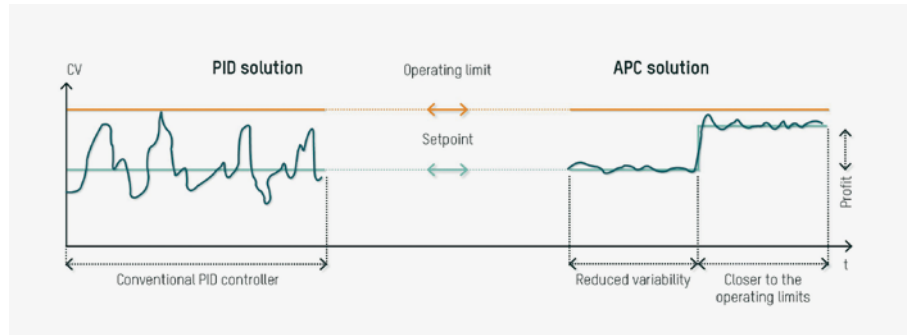
The sophisticated control algorithms of APROL APC aren't just available to those using the APROL process control system. They can also be implemented in existing plants as a standalone solution preinstalled on an industrial PC that requires no expert knowledge to use. The same industrial PC can double as an Edge Controller, aggregating data and sending it to higher-level systems – even into the cloud – for analytics and other services.

mance of control loops and manufacturing assets. This enables operators to maintain optimal control settings and run their processes closer to their limits. "An optimized control loop helps prevent unplanned downtime, making machines and plants more efficient and profitable to operate," says Reichinger.

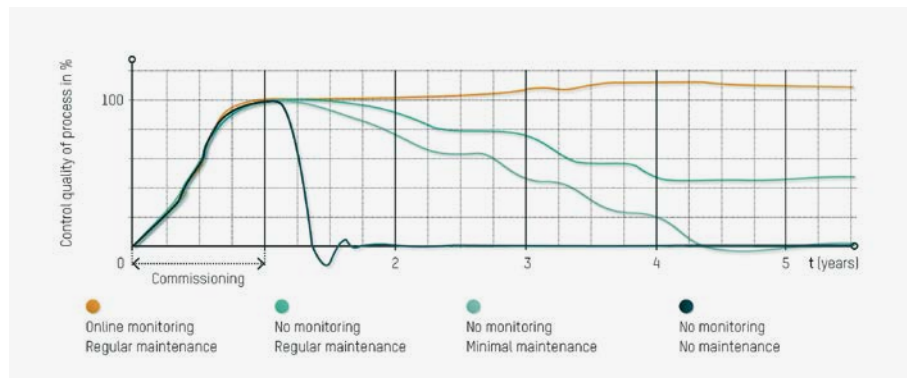
### Defining operating limits

When a control loop has multiple variables that interact with each other, a classic PID controller is not sufficient. "That doesn't keep most developers from trying to use them, though," says Reichinger. Not only does this result in suboptimal control performance, it can bring down the whole machine or plant if a value gets out of control.

"You can get substantially better results in these cases with a multi-variable controller," argues Reichinger. That's why BSR developed a model predictive controller (MPC) that supports multiple controlled, disturbance and manipulated variables – up to ten each. While the MPC does have to be set empirically, according to Reichinger, the job is manageable: "Using the faceplate, automation engineers simply select the desired transmission behavior and set a few parameters. With a few rounds of optimization, they should be able to have an MPC running optimally." The introduction of the MPC controller has yielded some impressive results thus far. "Plants that had been experiencing multiple unplanned stoppages per week suddenly run smoothly for months on end after switching to MPC," recalls Reichinger. ←



Advanced process control allows controlled variables to be run closer to their operating limits.



To maintain their control performance over the years, processes require constant monitoring and upkeep.



**Martin Reichinger**  
Business Manager - Process Automation, BSR

"Two-thirds of all control loops are not tuned optimally."

# More efficiency, more communication



Process and factory automation:  
APROL R4.2 offers numerous new software functions



B&R has published a new major release of its APROL process control system. APROL R4.2 contains numerous new software functions, including improved cloud communication via OPC UA and MQTT. It also offers a modern new “Dark style” interface design option.

APROL R4.2 includes additional SSL/TLS communication options, as well as numerous new functions for optimizing the efficiency of plants and processes. These include asset performance monitor-

ing, new condition monitoring features, an extensive business intelligence solution and optimized alarm management. B&R has also expanded its advanced process control solution with new features such as a PID tuning block based on the finite frequency method.

### Plant status at a glance

The new “Dark style” design gives the operator station a clean, modern interface and makes operation easier and more intuitive. It is now also possible to view the overall state of a process in a convenient radar chart. Key process variables are displayed in a pattern that makes the plant operator’s job considerably easier.

### Redundancy at every level

The full range of redundancy options are now integrated as standard APROL features. This makes high-availability systems an attractive option, even for smaller applications. APROL supports redundancy at every level. Operator bus, process bus, runtime server and controllers can all be laid out redundantly using standard components. No expensive special hardware is required. ←



# EPSG holds Europe-wide student competition



The top five teams of the 4th Industrial Ethernet Awards were invited to a social networking event at the B&R Headquarters.

For the fourth time, the Ethernet POWERLINK Standardization Group (EPSG) held a competition calling for innovative projects and automation concepts based on the open industrial Ethernet protocol POWERLINK. All students at European universities and technical colleges were eligible to participate. The most innovative and creative projects were rewarded with prizes totaling €50,000 in value.



Go-kart racing in Salzburg stoked the participants' competitive spirit.



Applicable projects ranged from mechatronic applications to the creation of solutions for industrial applications by developing new devices with POWERLINK interfaces and even implementation of new features in the open-POWERLINK stack. The main requirement was that the projects were relevant to the topics of Industry 4.0 and the Internet of Things.

### Project submission

Each project each consisted of up to four students and a university supervisor – usually their professor. The students were preferably to come from a thematically relevant degree program such as electrical engineering, automation, computer science or technical mathematics. The goal was to build a functional prototype, accompanied by a scientific paper. The projects were evaluated based on multiple criteria. In addition to the creativity of the concept, how well it presented POWERLINK technology and adhered to the open-source philosophy, the judges looked at the overall quality of the engineering and the scientific paper.

Twenty-seven teams from ten countries had registered their projects by February 2017. Of them, the best five were selected by the four-person jury consisting of Stefan Schönneger (CEO of the EPSG), Wolfgang Seiss (Head of Open Automation Technology Solutions at B&R), Dimitri Phillippe (CEO of BE.services) and Carsten

Emde (General Manager of OSADL). The awards ceremony took place on October 20, 2017. In addition to their accommodations in Austria, the top five teams enjoyed an event that included dinner, go-kart racing, a tour of the B&R Headquarters and much more.



The winners of the 4th Industrial Ethernet Awards were rewarded not only with prize money, but also the opportunity to publish their projects as open access papers.





The group was captivated by a live horseshoe-making demonstration.

They were also able to publish their scientific findings as sponsored open access articles. This was particularly significant for the young scientists, since open access articles are read and cited much more often than others.

### The award winners

First place went to the team from the University of Valencia in Spain. Their project involved highly dynamic motion control based on image processing. The control loop includes an event-triggered camera connected via POWERLINK. This type of camera only measures changes from one image to the next and is therefore significantly faster than a conventional frame camera, which opens up new possibilities for innovative automation concepts. Second place was awarded to students from the Technical University of Kosice in Slovakia. They developed the "Pathfinder", an AGV for transporting materials in hospitals. Pathfinder is equipped with the latest B&R components and uses software stacks for autonomous localization, navigation and mapping. The strengths of the robotics system are cleverly combined with the Ethernet POWERLINK protocol.

The team from Germany's Karlsruhe Institute of Technology (KIT) developed diagnostics software for visualizing POWERLINK data traffic in a real-time network, including detailed analysis of pro-

cess and service data. Their efforts were rewarded with the 3rd place prize. Honorable mentions went to a second team from Karlsruhe Institute of Technology (KIT) and one from the University of Poitiers in France. ←



The winners dined together at the Hammerschmiede ("Blacksmith") restaurant.

Photos: B&R

Condition monitoring

# Records rolling off the line





ŠKODA automobiles unite tradition with technology, and the brand is enjoying increasing popularity that extends far beyond the borders of its Czech origin. Together with B&R, the company achieved a substantial boost in productivity at its headquarters near Prague in the city of Mladá Boleslav.



ŠKODA's story began in December of 1895, when two cycling enthusiasts – mechanic Václav Laurin and bookseller Václav Klement – founded a small bicycle production shop named Laurin & Klement. Four years later, they began building motorcycles as well, under the brand Slavia, making them the first motorcycle factory in Central Europe. By 1905, Laurin and Klement were manufacturing automobiles, achieving immediate success with its first model, the Voiturette A. In 1924, the company joined up with machine builder Škoda. Since 1991, Škoda has been part of the Volkswagen Group.

#### **Eliminate faults, increase productivity**

Škoda production has a strong emphasis on automation and robotics. To further increase output, the company was looking for a technology that would allow early detection of potential faults in order to prevent the high cost of unexpected downtime. Automation specialist B&R had what they were looking for.

“The paint shop is one of the most important parts of an automobile factory,” says paint shop maintenance coordinator Marek Melčák. “It is a key step in the production process due to the potential for bottlenecks. Since 1996, we’ve been continually increasing our capacity through the use of the latest technology. Instead of manual spray guns, the paint is now applied by robots – currently 184 of them. Great care also goes into the control of the transport

belts. Every minute that a belt is stopped comes at a high cost.”

The paint shop's pretreatment line is 250 meters long. At a speed of 11 meters per minute, one chassis leaves the line every 37 seconds – around the clock, 24-hours a day. The sprockets are a critical element of the conveyor system, so it is important that they are monitored to ensure the pretreatment line stays up and running. That's why Škoda was looking for a partner with special expertise in conveyor belt monitoring. The contract went to DIF from Bohumín, Czech Republic, a specialist in optical measurement systems and vibration diagnostics.

#### **Paint shop condition monitoring**

DIF presented a solution using B&R's APROL ConMon solution, based on the existing technology. The communication system would connect to the paint shop's existing network. Diagnostics data could therefore be exchanged between the X20 controller and the Automation PC 900 industrial PC without needing an extra network, as would have been required by other bidders. Another key requirement was the number of secure IP addresses. With the B&R solution, only one IP address would be needed to exchange data between the PC and controller for 100 measurement points. The control system communicates between diagnostics stations via real-time Ethernet POWERLINK. In comparison, other proposed solutions



At a speed of 11 meters per minute, one autobody leaves the line every 37 seconds – around the clock, 24-hours a day.

would have required one IP address for every four measurement points. These and other factors convinced ŠKODA that they had found the right partner in B&R.

To meet the requirements defined by the paint shop specialists, DIF developed a solution centered around conveyor belt monitoring. "It was no easy task," recalls DIF Managing Director Radim Falc. "When a sprocket is rotating slowly – in this case 23 seconds per rotation – it is difficult to diagnose. We could never have completed such an extensive project without the meticulous work and experience of our maintenance technicians."

The overall solution was developed in collaboration between Škoda, DIF and B&R. "We had a good experience with B&R a number of years ago developing vibration diagnostics for industrial ventilation and conveyor systems. Here at the Škoda plant, we use B&R's APROL system for factory automation. At the paint shop, the APROL ConMon solution is used for online vibration diagnostics. This enabled us to improve

product quality, increase system availability and significantly reduce our maintenance costs," says Falc.

A total of 366 vibration sensors (accelerometers) are mounted throughout the production line, each measuring 16 vibration parameters. The data is sent to an Automation PC 900 via POWERLINK. This allows faults to be prevented in the harsh conditions of the paint shop. "The system works on the assumption that the early stages of bearing damage result in an increase in vibration energy at the higher frequencies," explains Falc. "This method also works to detect lubrication problems or jammed components." The information gained from this process is stored permanently and evaluated.

#### **B&R developed solution for online diagnostics**

Both the hardware and software technology for online diagnostics were developed by B&R. B&R engineers adapted the software to the diagnostics system, relying on know-how from DIF. "The greatest advantage was that we were able to use the ex-





To improve product quality and increase system availability, the paint shop uses BSR's APROL ConMon solution for online vibration diagnostics.

**Marek Melčák**

**Paint Shop Maintenance Coordinator, ŠKODA**

"The investment in condition monitoring has already paid off through a significant increase in production capacity and zero unscheduled downtime."

isting paint shop network and didn't need to implement a whole new network between the Industrial PCs and the measurement stations on the painting lines," says Radim Křístek from B&R's Ostrava office, who was also involved in the project. "An added benefit of our approach is that the system can be expanded modularly. That means you can start a pilot project with ten measurement points and easily scale it up to a hundred," says Václav Pravda, branch office manager at B&R Prague.

#### **New project with B&R already in planning**

After a year of condition monitoring, Škoda is clearly satisfied with the results at its Mladá Boleslav plant. "Thanks to this project, the sprockets in our paint shop are working perfectly, without a single fault. The investment has already paid off through a significant increase in production capacity. We've gone from 2,180 autobodies per day to 2,200. So we're already planning to implement early-warning diagnostics for our ventilation system as well," says Melčák. ←

# More performance for compact industrial PC



Equipped with Intel Atom processors from the Apollo Lake generation, the Automation PC 2200 is available in either box PC or panel PC format.



## **B&R introduces successor to Automation PC 2100**

Automation PC 2200 is the latest generation of B&R's successful 2000 series of compact industrial PCs. Equipped with Intel Atom processors from the Apollo Lake generation, the Automation PC 2200 is available in either box PC or panel PC format. Despite its compact dimensions, the Automation PC 2200 is a full-fledged PC system. Available with either dual or quad core processors, the Automation PC 2200 offers

fully scalable processing power. Thanks to B&R Hypervisor, the Automation Runtime real-time operating system can run simultaneously alongside Windows 10 IoT Enterprise or Linux. The Automation PC 2200 is perfectly suited as an IoT gateway or as a full-fledged edge controller or edge device.

### **Flexible HMI connection**

In its box PC format, the Automation PC 2200 can be equipped with an optional SDL4 interface. This digital transmission

technology allows HMI panels to be operated at distances of up to 100 meters.

### **Totally maintenance-free**

The Automation PC 2200 is free of fans and other rotating parts, making it completely maintenance free. Other standard features include two Gigabit Ethernet interfaces and two USB 3.0 ports. Fieldbus connections like POWERLINK and CAN can be configured individually. Compact CFast cards with up to 256 GB are used for data storage. ←



# B&R India under new leadership



Jhankar Dutta took over as managing director of B&R India on January 1, 2018.



## Jhankar Dutta takes over as managing director

On January 1, 2018, Jhankar Dutta took over as managing director of B&R India. Jhankar brings with him sixteen years of experience in various sectors of machine and factory automation. He began his B&R career on the International Sales team in Austria and subsequently headed one of B&R India's major branch offices. Jhankar's predecessor, PV Sivaram, will continue to support B&R India in his new role as non-executive chairman. Sivaram led the company with great success since its inception in

1998. After completing his degree in electrical engineering and communication, Jhankar started his career as an automation sales engineer in 2001. Through his various roles in product and project sales, project management, business development and other leadership positions, he gained extensive field experience and worked closely with customers in a wide variety of sectors. His success has been driven by a customer-centric approach and professional qualifications in business management that have given him a deep understanding of customer needs.

## Taking B&R India to the next level

B&R has grown consistently over the years, with customers playing a vital role in this success. "Technology is evolving rapidly, and B&R leads the industrial automation market with breakthrough solutions that bring ever greater value to our customers," says Jhankar. "We look forward to working closely with them to achieve our goals together." With his dynamic nature and customer focus, he aims to help B&R customers build machines and factories that are more productive, efficient and sustainable. ←



Human-robot collaboration

# The man-machine dream team

It's one of mankind's age-old dreams: humans and robots working shoulder-to-shoulder in perfect harmony. Humans' fine motor skills and ability to learn from experience give them an edge in terms of flexibility, whereas robots are able to handle tedious and strenuous tasks with unfailing quality and repeatability. Combining the best of both worlds can help optimize existing processes or give rise to entirely new ones. In its demo cell showing the assembly of a car tailgate, EngRoTec proves that, even under the formidable conditions of heavy-duty robotics, true human-robot collaboration (HRC) is far more than just wishful thinking.





The scene is impressive to behold. A 2.7-meter-long robot with a maximum capacity of 220 kilograms transports the entire tailgate of a car to a mounting fixture, as EngRoTec engineer Sebastian Filk watches from behind a strip of red LEDs that marks the boundaries of his workstation. If he were to step over the boundary, the robot would stop within milliseconds or continue working at a sufficiently reduced speed to not endanger its human operator. As soon as Filk's "colleague of steel" comes to a stop, the lights change to green and he can safely enter. After fastening two hinges, he exits the area again and pushes a button on the next terminal to complete the work process. The robot then takes the pre-assembled tailgate to the body, positioning it with laser-guided precision. Once again, the green lights tell Filk the workpiece is in the right position and it is safe to enter. Even as he screws the tailgate onto the body, the controller is already busy sending quality data to the ERP system and requesting the next workpiece. In the future envisioned by Industry 4.0, this kind of intimate teamwork will soon become the norm.

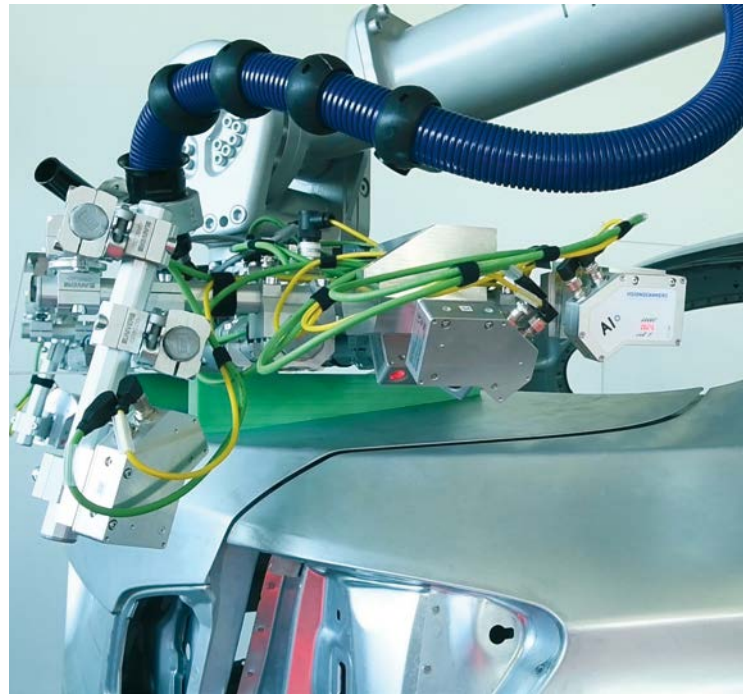
#### **Robots now service providers**

Service robots for housework and healthcare have been making headlines for quite some time. Direct human-robot collaborations are well suited to assembly and handling of small parts. Robots provide welcome relief for workers who would otherwise have to perform tasks overhead or in ergonomically undesirable positions.<sup>1</sup> Applications of this type involve lightweight robotics where the moving masses are small and the drives operate at reduced speed and force so as not to pose a risk to humans.

Things are quite different in the world of heavy-duty robotics. There are numerous applications in automotive manufacturing where hundreds of robots working in safety cells weld together entire car bodies. "Most applications can now be automated under these conditions," explains Marc Burzlaff, managing director of EngRoTec. "In the future, the key will be bringing humans into the process and combining their intelligence with the advantages of robotics." The result will be considerably more effective and flexible production processes and improved working conditions for operators. "With Industry 4.0 and the advent of mass customization, these advantages will only gain in significance," says Burzlaff.



The combination of openROBOTICS, BSR control and motion technology, openSAFETY light curtains and the SafeROBOTICS technology package achieves a safety response time of 250 milliseconds.



The tailgate is measured by a multi-sensor system that takes all tolerances into account. The optimal positioning is calculated and the robot adjusted accordingly.

### Heavy-duty robotics demand serious safety

With humans and robots working and moving in the same physical space, contact between them is inevitable – possibly even intentional. The high risk of injury makes ensuring operator safety a primary concern. Applicable guidelines for doing so can be found in the standards DIN EN ISO 10218 and ISO/TS 15066.<sup>2</sup> Required safety clearances for specific tasks can be derived, as well as maximum movement speeds and requirements for workspace monitoring. The demands on the safety technology used are correspondingly high.

Having executed numerous HRC projects in the automotive industry, Burzlaff knows that the response time of the entire safety chain can be a make-or-break factor in the success of an HRC application. "If you can get the safety response time under 350 to 400 milliseconds, you can reduce safety clearances by up to 50% compared to the current state of the art," he explains. This in turn reduces the overall equipment footprint. Workers benefit from shorter distances to travel and more ergonomically designed workstations.

Conventional MRC solutions are based on standard robots with their own control systems, separate cell control and safety technology. Decentralized management of the numerous safety parameters and communication between systems require an enormous amount of development work. "With that level of complexity, it's not possible to achieve response times under 500 milliseconds," says Burzlaff.

### openROBOTICS makes it possible

In 2015, EngRoTec developed the AI robot control system that made robot-assisted and tolerance-optimized tailgate mounting possible. This field-proven and trade-association-approved application has now been further developed in a new HRC demo cell. "Being

able to realize these scenarios for our customers in a cost-effective way was a primary focus of our work," says Burzlaff. "To make it possible, we had to re-evaluate our automation solution from the ground up."

After in-depth market research, the EngRoTec engineers decided on a Comau robot, augmented by B&R's freely configurable control technology. The result of this cooperation is called openROBOTICS and allows this type of robot to be tightly integrated into the overall system. "Comau dispensed with its own robot control, which significantly reduced the complexity of the automation technology. Furthermore, the B&R technology used for control, motion and safety technology and the SafeROBOTICS technology package not only dramatically reduced the engineering cost, but also the safety response time," says Tobias Daniel, head of sales and marketing for robotics at Comau.



**Marc Burzlaff**  
Managing Director,  
EngRoTec-Solutions GmbH

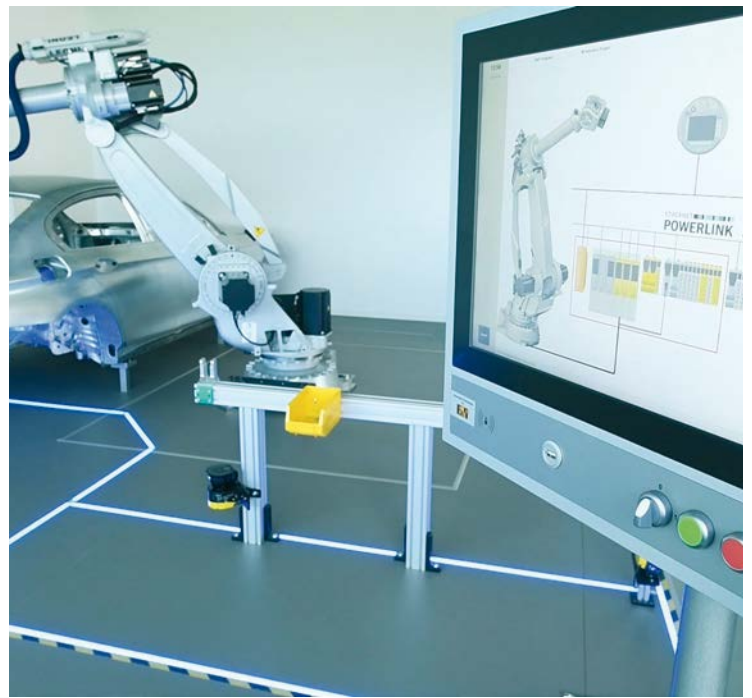
"In the future, the key will be bringing humans into the process and combining their intelligence with the advantages of robotics. With Industry 4.0 and the advent of mass customization, these advantages will only gain in significance."

<sup>1</sup> BGHM [2016] Trade Association for Wood and Metal, Fraunhofer IFF Magdeburg carries out research on behalf of the BGHM for man-robot collaboration in Industry 4.0; <https://www.bghm.de/bghm/pressteservice/pressemeldungen/detailseite/sichere-zusammenarbeit-von-mensch-und-roboter/> (viewed on 11/14/2016) <sup>2</sup> Schenk [2012], Michael Schenk, Norbert Elkmann: Safe man-robot interaction, requirements, conditions, scenarios and proposed solutions. Demographic change - a challenge for the work and company organization of future series by the Academic Society for Work and Industrial Organization (IAB), Egon Müller (publisher)





The robot assumes a safe stop state, holding the workpiece in place while the hinges are fastened manually.



LED strips in the floor mark workspace boundaries and indicate when it is safe to enter.



**Markus Sandhöfner**  
Managing Director, B&R Germany

"The use of B&R technology – our flexible hardware and software components combined with extremely efficient integrated safety technology – will be pivotal in helping establish HRC technology in manufacturing."

### B&R sets standards with SafeROBOTICS

These solutions really play to B&R's strengths as a system provider. Control, motion and integrated safety technology can be freely selected and configured. The performance of real-time Ethernet POWERLINK with openSAFETY and the ability to complete all engineering using B&R's Automation Studio won over EngRoTec's developers. B&R further supports their engineering work by providing an array of technology packages.

One such package, SafeROBOTICS, performs a variety of important functions that can be used to implement HRC applications for a wide range of different tasks. For example, multiple flanges, joints, monitoring and tool center points, as well as up to 20 cuboids or planes placed anywhere in the space can be simultaneously safety-monitored and reconfigured in real time. To make configuration easier, this data can be applied directly from a simulation tool.

SafeROBOTICS also includes safe motion control functions which monitor the movement of the robot's tool center point (TCP) and ensure safe positioning, speed and orientation of the robot. Without these functions, an HRC application would be difficult or impossible to implement.

With them, the response time of the safety application can be reduced dramatically. "In this application, we've achieved a safe 320-millisecond reaction from the time the laser scanner detects a workspace violation to the time the drives are safely shut down. That's a world record," notes Markus Sandhöfner, managing director of B&R Germany. The performance further benefited from the expertise of EngRoTec, who was able to eliminate the need for a lot of hardware and other equipment through intelligent, database-supported software and controller design.

### Increasing productivity and reducing workload

Burzlaff sees customer benefits particularly in the reduced safety clearances and control cabinet footprint. The drastically reduced space requirements bring noticeable improvements for production line workers in terms of the distances they have to cover. In the case of the EngRoTec demo cell, this means 15 fewer square meters of floorspace, 40% less distance to travel and a cycle time reduction of 7%.

"If we do even more database-driven work and cut down on further hardware by using openSAFETY light curtains, we will be in a position to reduce response times by another 70 milliseconds. These are huge leaps forward for human-robot collaboration on the assembly line," states Burzlaff confidently. It is safe to say that further advancing this technology is a worthwhile pursuit. ←

# Data acquisition, evaluation and transmission to the cloud



B&R presents powerful Edge Controller at Hannover Messe



A single device to acquire data, evaluate it and send it to the cloud – that’s now possible with B&R’s Edge Controller. The powerful industrial PC can even be used for big data analysis and machine learning, while at the same time serving as a full-fledged industrial controller. B&R’s

Edge Controller is based on the robust Automation PC 910, whose high-performance variant is equipped with an Intel XEON processor able to handle resource-intensive tasks like machine learning. The Edge Controller runs a hardened operating system – a commercial Linux variant with

guaranteed long-term support. Cloud transmission occurs via MQTT.

### Full-fledged industry controller

B&R Hypervisor makes it possible to simultaneously run a real-time operating system on the Edge Controller. That turns the edge device into a full-fledged industrial controller with cycle times in the sub-millisecond range. An unlimited number of I/O modules or controllers can be connected via the POWERLINK Industrial Ethernet protocol, OPC UA or other fieldbus systems. In the future, this will also be possible with OPC UA TSN. ←





Control performance monitoring

Plant automation

Advanced process control  
APC  
MPC

Process control

# Aspire higher APROL process automation

[www.br-automation.com/APROL](http://www.br-automation.com/APROL)

## Scalable

50 to 500,000 channels

## Reliable

High-availability at every level

## Flexible

For primary and secondary production

## Integrated

Same system software for all tasks



ETHERNET POWERLINK open SAFETY

PERFECTION IN AUTOMATION  
A MEMBER OF THE ABB GROUP



Integrated automation  
Global presence  
Solid partnership



ETHERNET   
**POWERLINK**

open   
**SAFETY**