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The B&R Technology Magazine

Integrated Machine Vision

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OEE Industrial IoT for brownfield plants

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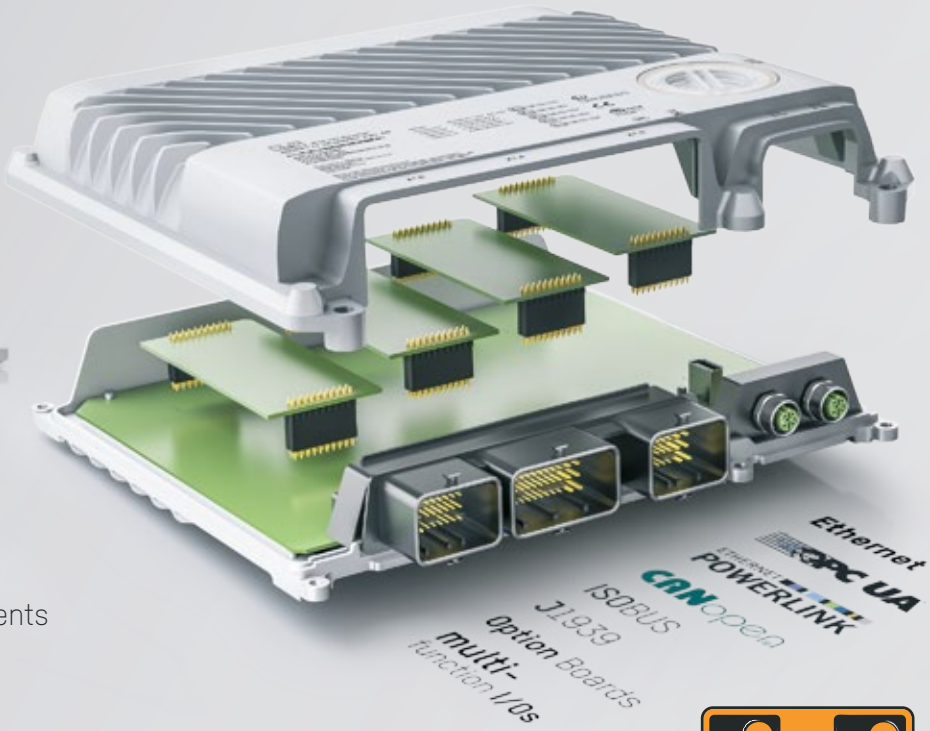

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Media owner and publisher:
B&R Industrial Automation GmbH
B&R Strasse 1, 5142 Eggelsberg, Austria
Tel.: +43 (0) 7748/6586-0
automotion@br-automation.com

Managing Director: Hans Wimmer

Editor: Alexandra Fabitsch
Editorial staff: Craig Potter
Authors in this edition: Carmen Klingler-Deiseroth, Dr. Peter Ebert, Thomas Schmertosch, Stefan Hensel, Franz Joachim Rossmann, Alexandra Fabitsch

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Dear Reader,

Industrial manufacturers have relied on computer-assisted image processing for many years, particularly in the areas of quality inspection and optical identification. The range of applications continues to grow rapidly, yet a number of hurdles remain to be cleared before the technology can truly take off. Not only are machine vision tasks becoming increasingly complex, there is also the broader question of how best to integrate them into the automation landscape.

These transitions will be helped along by the availability of extremely compact embedded vision systems designed for industrial use, as well as more user-friendly tools for developing image processing applications. Today, the most integration you'll see is the ability to add a software block into the finished application to support an external image processing system. The OPC UA Vision Initiative recently kicked off by the VDMA is an important step towards integrating image processing into machines more efficiently. The full potential of machine vision can only be achieved, however, if it is integrated into the machine at every level.

If a vision application is meant to function as an integral part of the machine automation, the first thing you need is an engineering tool that allows it to be developed as such. Not only does this streamline the engineering workflow, it brings the added value of access to alarms, user data and recipe management systems. If you allow image processing to use the controller's real-time communication, you'll have no problem achieving microsecond synchronization and runtime parameter changes for self-optimizing control loops. If you synchronize the process variables for motion control, I/O and image processing, you transform machine vision components into seamlessly connected smart sensors. If you give a machine eyes, you open up a whole new world of innovative designs for the smart machines and factories of tomorrow.

But, *seeing is believing* – so be sure to visit us at Booth 206 in Hall 7 of the SPS IPC Drives from November 28–30 in Nuremberg. We would love the chance to explore all the exciting opportunities that seamlessly integrated machine vision could hold in store for you. We look forward to seeing you there!

Happy reading!

Andreas Waldl
Innovation Manager, Controls

contents

Integrated Machine Vision

Look beyond embedded

Machine vision is playing an increasingly important role in modern manufacturing. Self-optimizing production processes, for example, rely on real-time feedback from imaging-based inspection. So far, however, even the most advanced machine vision systems have been impaired by inadequate integration into the control system at large. B&R's new fully integrated solution is now set to unleash the full potential of machine vision.

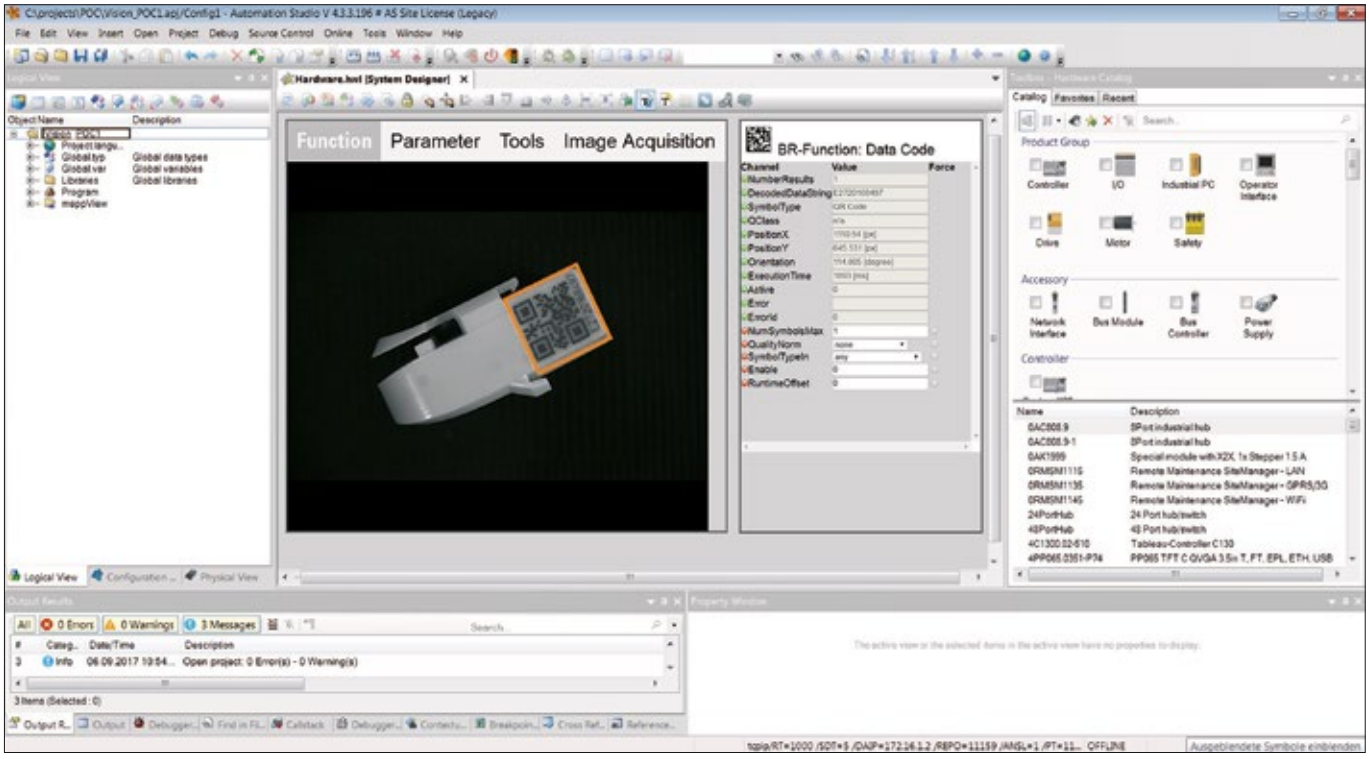
"Seeing is believing," the old adage tells us. Indeed, vision is the most trusted of the human senses – and the one we use most to interact with the world. "In contrast," says Andreas Waldl, product manager for integrated machine vision at B&R, "many of today's machines are more or less flying blind."

For years, OEMs have been trying to resolve this shortcoming by means of machine vision. As companies work toward implementation of Industry 4.0, such vision systems can be a valuable tool. "At the moment, however, machine control and machine vision still live in two different worlds," says Waldl. Incorporating a machine vision system into an application remains an extremely complex task.

Machine vision by B&R

"We have developed an embedded vision system whose flexibility and unprecedented level of integration eliminate the drawbacks previously associated with these systems," says Waldl. At the heart of the solution is a broad selection of intelligent camera technology. Options at the lower end will replace simple machine vision sensors, while the top of the range will harness the full potential of high-end smart cameras. These cameras are capable of performing a wide range of machine vision tasks that are currently still being carried out by PC-based systems.

A key component of B&R's machine vision system is smart lighting technology, which is available integrated in the camera, as an external device, or even as a combination of the two. Automatic lighting modulation prevents stray light and other difficult lighting conditions from compromising performance. It also makes it easy



B&R has fully integrated machine vision into its Automation Studio engineering tool.

to achieve extremely precise synchronization for high-speed image capture or accommodate object-specific requirements such as bright-field or dark-field illumination.

Perfect integration

"B&R's machine vision system is integrated on every level: the engineering tool, the real-time operating system and the application software," emphasizes Waldl. The holistic approach encompasses every aspect of an automation solution: from the control system to the safety technology and from motion control to robotics and CNC. "And now that includes machine vision as well."

With cameras and lighting just as integral as I/O modules, servo drives and safety controllers, there's no longer a need for interfaces in the runtime system. Tasks like programming and configuring image processing routines, as well as the settings for the camera and lighting, all become part and parcel of the overall automation project.

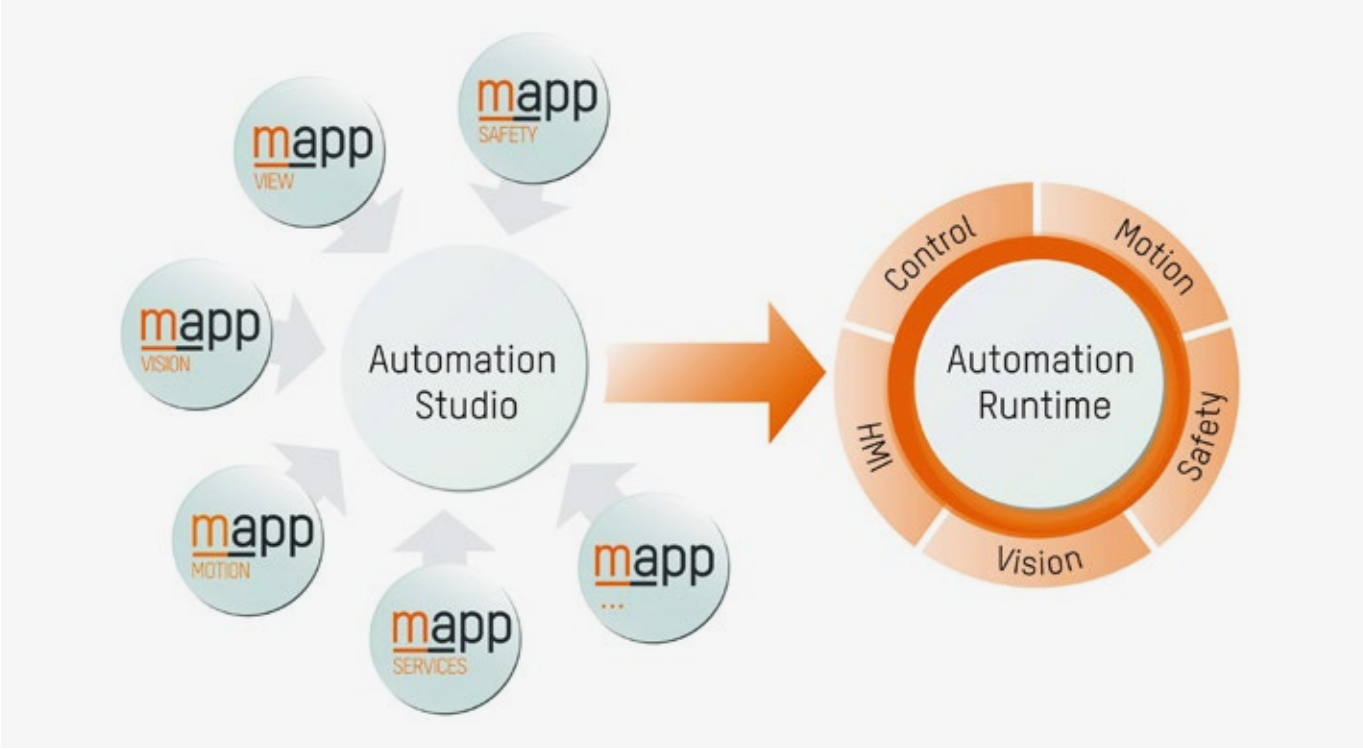
Control programmers are able to carry out numerous machine vision tasks themselves. All data, parameters and variables are standardized throughout the entire system – no separate process variables are required for machine vision. The only time vision specialists will need to be consulted is in situations that require their specific expertise, for example in handling difficult lighting conditions.

Simple programming

B&R's mapp Technology framework provides ready-made software components that make it easy to create machine vision applications with minimal programming. Since mapp components communicate intuitively with one another, all it takes is a few clicks to do things like integrate images captured by a smart camera into a mapp View HMI application. And all without writing a single line of code. The camera and lighting parameters as well as trigger conditions can all be changed on the fly, making product changeovers and other runtime adjustments very easy to implement.

Andreas Waldl
Product Manager – Integrated Machine Vision, B&R

"The first truly integrated machine vision system opens up a new world of opportunities for machinery and equipment manufacturers."



Like all of its automation products, B&R's machine vision system is programmed using the ready-made components of mapp Technology. The resulting application covers everything from process control and motion to machine vision and HMI.

Infinite possibilities

Potential applications for B&R's machine vision system range from relatively simple tasks – like reading barcodes, OCV and OCR – to the most demanding tasks found in pharmaceuticals, printing and textiles.

The different camera models can be scaled seamlessly and are all based on the same technology. This allows OEMs to equip different machine variants with different configurations of the machine vision system. The software only needs to be created once, regardless of which hardware configuration is installed. Since the application is also stored on the controller, no data is lost if the camera is replaced during servicing.

Sub-microsecond synchronization

Cameras and lighting are directly integrated into the real-time network via POWERLINK, which not only ensures tight synchronization with machine and motion control, but handles HMI communication as well.

Rather than following the circuitous route they've been forced to take in the past, trigger signals come directly from the controller or motion application. The ability to synchronize image triggers and lighting control with the overall automation system – in hard real time and with sub-microsecond precision – opens up a new world of opportunities. In dynamic applications with frequently changing speeds, for instance, you no longer need a separate encoder on the camera input.

Users can choose from different performance levels, image sensors and optics.

By fully assimilating machine vision into its automation system, B&R now allows machine builders to implement both control and machine vision tasks with a single tool. As Waldl summarizes: "Rather than struggling with the inadequacies of traditional vision systems, they can refocus that energy into optimizing their machine's value-adding processes." ←

"There's nothing else like it on the market right now"

B&R is kicking off the fall season with a big surprise: presenting its very own machine vision solution at this year's SPS IPC Drives. In an interview with the German trade journal *SPS-Magazin*, B&R Managing Director Hans Wimmer discusses what benefits can be expected from the company's integrated machine vision solution.

Hans Wimmer, Managing Director, B&R

There's no shortage of machine vision suppliers on the market. What compels B&R to step into the arena?
To paraphrase your July editorial: It will not be possible to implement Industry 4.0 without machine vision. We share that view. The integration of machine vision will lead to higher quality and increased productivity for tomorrow's machinery and equipment. At the moment, the big problem facing users is that machine automation and machine vision still occupy two separate worlds. This is where B&R sees its role. Our solution joins these two worlds together by seamlessly integrating machine vision into machine automation.

What does this integration mean for users?
Integration is the key to successful automation. It's an approach that has always served us well, and more importantly it's one that has brought our customers real benefits. Past examples include the integration of CNC and robotics, as well as things like safety and web-based HMI. The B&R system landscape encompasses all these technologies and more. Our customers don't need separate engineering platforms, programming languages or maintenance tools for each domain: it's all fully integrated in B&R Automation Studio. Since no interfaces or gateways are needed, users enjoy the benefits of extremely fast response and cycle times as well as optimal synchronization. You can't do these things the old way.

What does that mean in the case of machine vision?
We'll be offering cameras, lighting and software functions. By seamlessly integrating these components into B&R's automation landscape, we've created a solution with some compelling technological highlights. PLC programmers will have no problem solving machine vision tasks using a B&R smart camera. The engineering tool is already familiar territory. And, just as simple and straightforward as axis synchronization is today, that's how easy it will be for them to implement perfectly controlled triggering and image acquisition. They'll also be able to do on-the-fly product changeover and make clock-synchronized parameter changes for the cameras and lighting. There's nothing else like it on the market right now. B&R's machine vision solution will be the eyes of tomorrow's most innovative machinery and equipment. ←

Original interview conducted by Dr. Peter Ebert,
Editor-in-chief inVISION, SPS-Magazin

Industrial IoT

Striking brownfield gold

Source: B&R

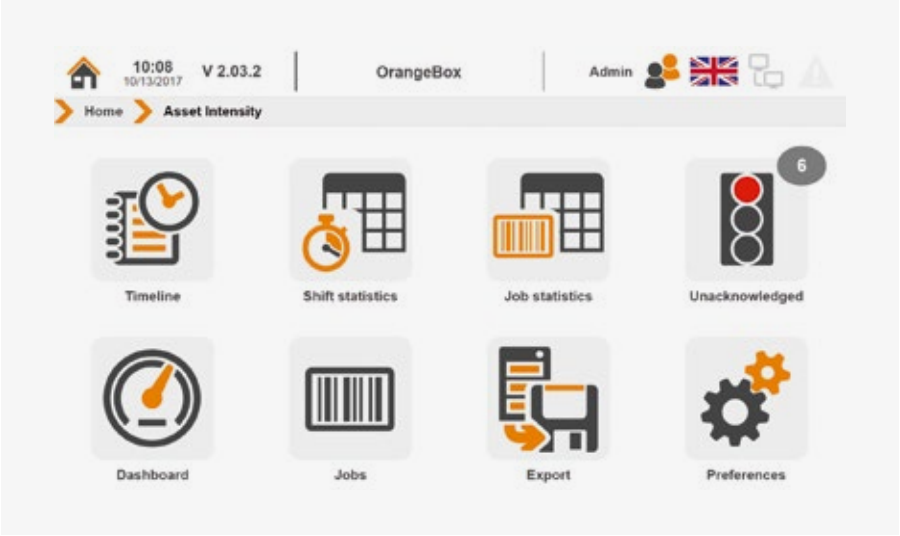
Data is the currency of the future. To unearth the wealth of information hidden just below the surface of today's brownfield plants and machinery, B&R developed the Orange Box. Among the first to use this remarkably simple and convenient solution was the Vehicle Dynamics unit within Continental's Chassis & Safety division – retrofitting an existing plant with state-of-the-art data acquisition and analysis. Implementation was completed in minutes, and management was immediately rewarded with its first real-time overview of key performance indicators like overall equipment effectiveness (OEE).

"Our primary focus used to be on collecting and analyzing product-related order and material data, regardless of the level of automation in a production line," says Manuel Krebs, who leads the Central Control & Production IT Systems department within the Vehicle Dynamics unit. "With the growing range of options for integrating data into modern control systems, it becomes possible to broaden that focus significantly and to react much faster and in a more targeted way to stoppages and other availability issues."

The automotive supplier benefits from an optimal setup here. "In the Vehicle Dynamics unit, we plan and design all the production equipment for all of our production sites," notes Krebs. Responsibility for control technology, MES systems and production IT is all centralized in one place. This provides us with optimal conditions for a standardized and very structured approach to evaluating a wide range of production data."

Integrating existing plants into production IT

Older plants generally do not meet the technical requirements for collecting and evaluating sufficient amounts of data without intervening in the plant software. For companies who hope to get years of productive life out of their existing plants, to continue without closing this gap in connectivity is not acceptable. The Orange Box is an easy way for plant operators to clear the final hurdle in integrating existing



The smartphone-inspired design and functionality of the user interface make it intuitive to use without requiring any specialist knowledge.

plants – uninvasively and with minimal investment. This can be seen in the example of an existing Continental Teves plant at the company's headquarters in Hanover, which has been producing automotive air suspension systems for many years.

"B&R had our attention from the moment they introduced the Orange Box," recalls Krebs. "It promised an effective, direct way to get the answers we need to make targeted improvements in the efficiency of our brownfield sites. But, part of it was also just pure curiosity and enthusiasm for the technology," he admits.

Plant software remains untouched

The implementation requirements were clear and quite strict: first, the existing plant technology had to remain untouched to avoid compromising any existing guarantees or certifications. Second, production had to continue uninterrupted throughout installation and commissioning of the Orange Box. Third, the training overhead for Continental employees who would be using the system had to be kept to an absolute minimum. Having been designed for just such a situation, the Orange Box met all three conditions easily.

B&R offers three ways to establish communication between existing equipment and the Orange Box. If the existing controller has a fieldbus interface, the first option would be to use that. B&R has equipped the Orange Box with data interfaces for the most commonly used controls manufacturers, so all that remains is to select the one that applies.

If the controller is not supported directly – or if the plant has already been electrified but has no suitable fieldbus interface – the Orange Box can also use any I/O hardware that is in place. If this is also not an option, then the data can be extracted from the equipment using parallel wiring and additional sensors. Since the Continental plant in question already used a relatively modern line control system that was supported by the Orange Box, the project managers chose the easiest integration option using the existing fieldbus interface.

First data available in minutes

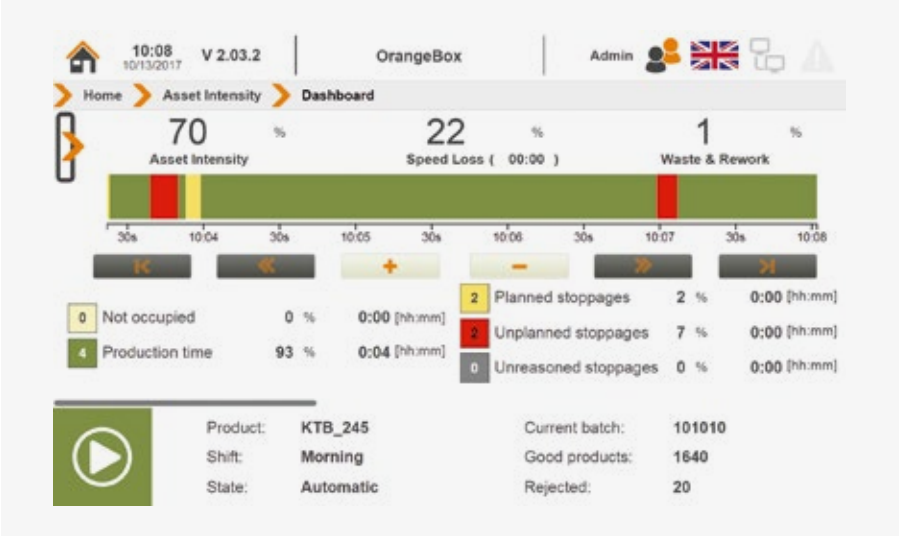
Once the Orange Box was installed in the control cabinet, using the same hardware platform as the standard B&R controllers, the system went live on an operational production system in July 2017. The first batch of data was available just a few minutes later.

"The only preparation involved on our end was to select the specific data points we were interested in," says Krebs. "All the aggregation and analytics is handled by the B&R software."

The modern user interface of the Orange Box makes it very easy to configure, analyze and visualize the collected data. Without writing a single line of code, the individual data points can be linked in a visual editor using Boolean operators to create graphics that visualize OEE and other KPIs. "Configuring instead of programming – that's what sets the Orange Box apart," says Krebs.

Configuring, not programming

With mapp Technology, simple configuration replaces tedious programming. The user interface for the Orange Box was created using mapp View – B&R's HMI solution based 100% on web standards. mapp View ensures optimal viewing on any display hardware in a standard browser and makes it possible to implement intuitive operating concepts that will be familiar to any smartphone user. Icons on the home screen provide easy access to the most important functions. Below them, a dashboard displays key efficiency metrics. Users can choose the functionality they need from B&R's constantly growing range of mapp components and expand the tool one module at a time with minimal new engineering work. For example, plant operators can use mapp Tweet to send alarms or other important



The Orange Box dashboard provides a fast, informative overview of a plant's most important efficiency metrics – in real time and from any location – allowing well-informed operators to implement corrective measures quickly and precisely where they are needed.

notifications to their smartphone, or use mapp Data to backup data in higher-level databases via OPC UA.

A fast way to improve efficiency

In implementing the Orange Box, Continental's primary focus was on gaining insight into the factors with the greatest impact on plant availability, particularly with regard to unplanned stoppages.

"The Orange Box provides this and other OEE metrics quickly and easily," reports Krebs. "Production supervisors can quickly gain an overview of asset efficiency, ask the right questions at the right times, and effectively drive measures to improve efficiency. It's exactly what we were looking for."

What is mapp Technology?

B&R mapp Technology streamlines implementation of frequently recurring programming tasks for basic machine functionality by providing thoroughly tested ready-made software components. Programmers can then concentrate on their main task: implementing machine processes in the application software. The mapp components are seamlessly integrated into the B&R Automation Studio development environment. Easily configurable mapp components save programmers the tedious task of coding each and every detail. ←

The Orange Box data acquisition and analysis system from B&R allows users to easily link data points via a visual editor. This gives them quick access to a structured overview of the causes of unplanned stoppages.

Manuel Krebs
Head of Central Control & Production IT Systems, Continental Teves

"The Orange Box gives us an ideal tool for integrating our brownfield plants into our IT and data structures seamlessly and with minimal effort. It gives us real-time insight into OEE data that was previously only available with a delay or simply not utilized, and in a clearly organized and reliable way that allows transparent analysis."

Source: B&R

Mass customization

The era of individualization has only just begun

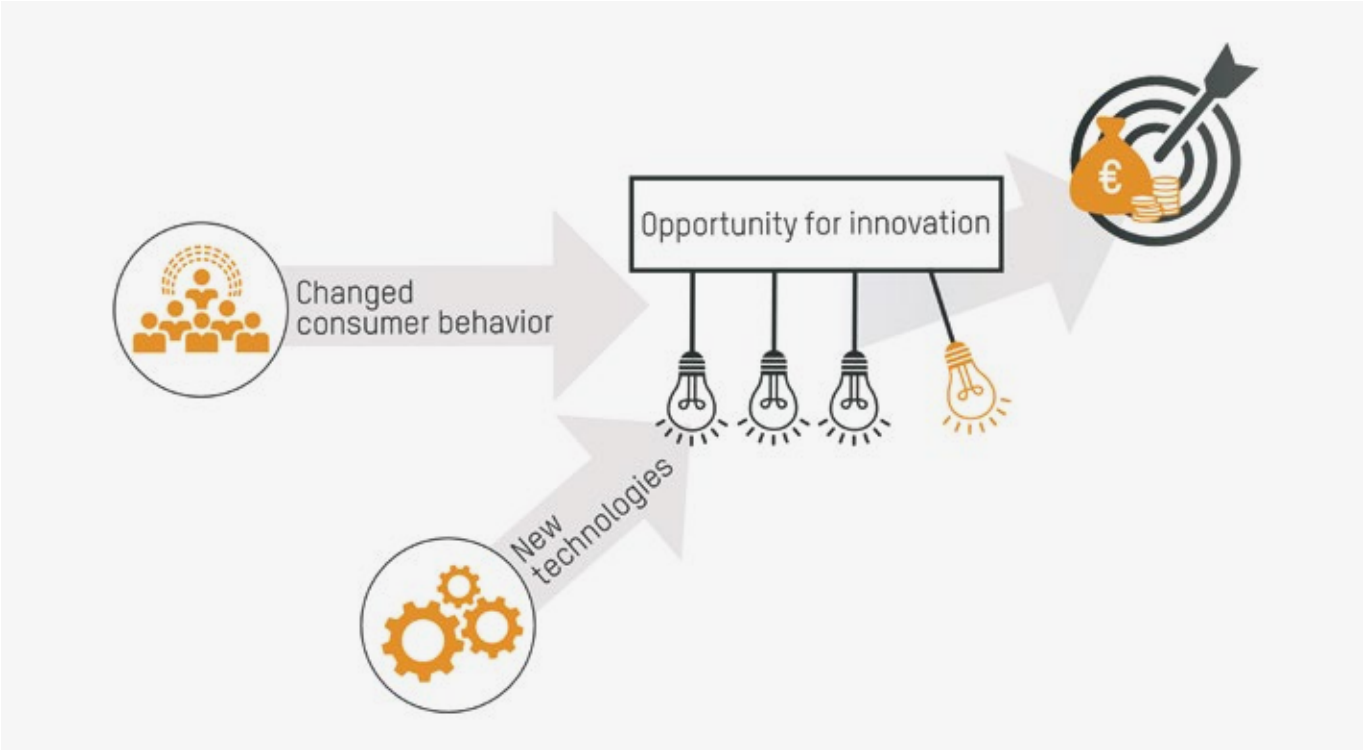
For today's generation of digital natives, the ability to personalize the products they buy is increasingly expected as a given. To keep pace, the makers of these products need highly flexible manufacturing systems that are at the same time efficient and profitable. This introduces a whole new set of demands on plant infrastructure.

The variety of options available for customizing mass-produced products continues to grow. It's no longer limited to the usual suspects like breakfast cereals, cars and photo books. Particularly among the younger generation of digital natives, there is a growing desire to fine-tune every online purchase to match their individual tastes and preferences. "The era of individualization has only just begun," declares Robert Kickinger, mechatronic technologies manager at B&R.

Profitable production at batch size one

Batch-size-one production is nothing new, really. In fact, it's standard practice in many craft businesses. "What is new, however, is the idea of making customized products under mass-production conditions," asserts Kickinger. So far, this has proven difficult to implement in a way that is economically viable. That's because any increase in system flexibility is usually accompanied by a reduction in overall equipment effectiveness (OEE). "When that happens, individualization is no longer profitable."

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 their return on investment (ROI) and



The convergence of new technologies and growing demand for personalized consumer goods creates new opportunities for adding value.

minimize their time to market (TTM) for new and improved products. "This is the only way to make mass customization viable from an economic perspective."

Up to now, developing flexible manufacturing systems has been a tedious process. "In many cases, you don't see the problems until the system is actually up and running," explains the mechatronics expert. At that point, fundamental changes to the machine design can extend the time to market by months. "That can be very costly." If the system as a whole or individual components can be simulated and tested in advance, the time to market can often be reduced dramatically.

Fast changeover

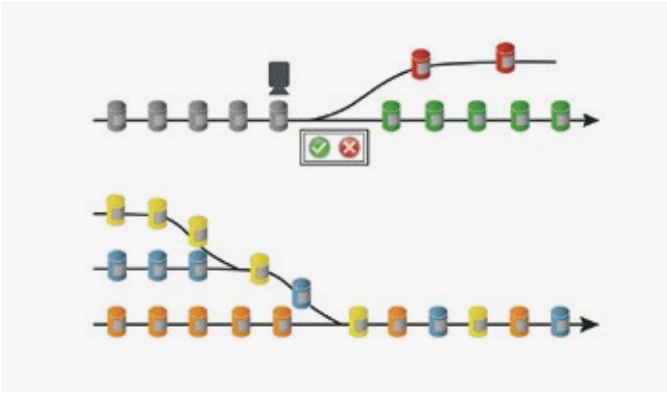
Once the system is in operation, availability becomes a decisive factor and changeover times play an important role. "The kind of individualized mass production we'll see in the future will be characterized by near real-time processing of online orders," explains Kickinger. By defining the features of the products they order online – from cars to printed products – today's customers have already assumed a highly-automated role in the production process. "This will soon be the standard approach for a much broader range of products," he maintains. To ensure system availability and profitability, changeover times will need to be kept to a minimum or even eliminated entirely.

Yet, it's not just the products themselves that are becoming increasingly customized; the same holds true for how they are packaged. A bottling line that produces three different beverages, for example, should also be able to combine them into any conceivable six-pack arrangement. "That's simply not possible on a conventional line," says Kickinger. The constant changeovers would throttle productivity. "What's needed is a solution that allows flexible integration of product flows in real time and at full speed."

SPS IPC Drives: The future of individualization

At the 2017 SPS IPC Drives trade fair, B&R will be presenting a new product that will simplify mass customization dramatically. The product will be unveiled at the B&R booth (Hall 7, Booth 206) on Tuesday, November 28th at 9:30 AM. The event will be broadcast live around the world on YouTube.

Flexible plant infrastructures respond effectively to the economic challenges posed by modern manufacturing.



Mass customization relies on the ability to split and merge product flows flexibly.

A flexible machine is able to arrange any combination of products for end-of-line packaging.

Real-time rejection

To ensure sustained high quality, lines must be able to react to faults and defects in real time – without compromising the production process. "Defective products need to be rejected on the spot, while maintaining full production speed," says Kickinger. If a defective item is not sorted out immediately following quality inspection and is instead permitted to continue down the line, it will eventually become necessary to scrap an entire package full of products.

It's not only products that can be defective, however. If one valve in a bottling line stops working, for instance, the automation system should react intelligently by no longer sending bottles to that station, while the process as a whole continues uninterrupted. Kickinger notes that there have traditionally been two options in such a scenario: "Either I let the process keep running and scrap all the products affected by the faulty valve, or I stop production altogether." From an economic perspective, neither alternative is particularly attractive.

Scalability and ROI

In most cases, a conventional manufacturing system doesn't scale easily. To increase output, it's necessary to either add a second line or replace the existing line with a larger one. These options require considerable investment and eat up valuable floor space. "But, it doesn't have to be that way," promises Kickinger.

In a rigidly-timed process, the slowest station determines the maximum output rate. To increase output, the automation solution needs to enable more dynamic timing of processing cycles. If you're able to perform those slower processing steps at multiple stations in parallel, you can multiply productivity without a proportional increase in the machine footprint. Such an approach hinges on the ability to split the product flow and then merge it back together farther down the line.

If the line also allows you to add and remove stations on site, that opens up additional possibilities to adjust capacity to changing demand. "Manufacturing technology that adapts to your production requirements: that's ROI you can take to the bank," says Kickinger.

Competitive advantages

ROI, OEE and TTM are the main economic factors underpinning all manufacturing operations. In this context, both the builders and operators of machinery and plants must rise to the challenge of increasing production flexibility. "Fail to take this seriously and you will find yourself at a competitive disadvantage," warns Kickinger. Mass-customized products have been shown to achieve higher margins than their conventional counterparts. Successful implementation, however, stands or falls with key advancements in plant infrastructure. ←

Author: Carmen Klingler-Deiseroth, freelance journalist

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B&R steps up efforts advancing OPC UA

Automation specialist appointed to OPC Foundation's Technical Advisory Council

B&R is now represented in the OPC Foundation's Technical Advisory Council (TAC). This move further strengthens B&R's role in the strategic advancement of the OPC UA standard. Appointment to the TAC is a tribute to B&R's committed involvement throughout numerous OPC Foundation working groups.

Drawing its membership from the likes of Microsoft, SAP, Rockwell and Siemens, TAC is the highest technical body within the OPC Foundation. The council is tasked with setting the strategic course for advancing OPC UA in a way that maximizes user benefits. It has the authority to establish technical working groups and approve new OPC UA specifications.

Pub/Sub and TSN

B&R will be represented in the TAC by Dr. Dietmar Bruckner. As Technical Manager of Open Automation Technologies at B&R, Dr. Bruckner is responsible for all development activities surrounding OPC UA TSN. "I'm very much looking forward to working in the TAC," he says. "Together, we will make rapid progress in the development of Pub/Sub and TSN. In combination with application-specific OPC UA companion specifications, we will very soon be able to offer a uniform standard for seamless communication from the sensor to the cloud."

Dr. Dietmar Bruckner represents B&R on the OPC Foundation's Technical Advisory Council.

Flight control systems

Affordable safety ready for takeoff

The research plane of the Technical University of Munich shortly before takeoff.

The importance of flight control systems for protecting passengers and aircraft is indisputable. Nevertheless, these costly systems rarely find their way onto smaller planes. Through its partnership with the Technical University of Munich (TUM), Diamond Aircraft plans to change this. They are working together on innovative technologies and assistance systems which will increase the safety of small aircraft. The use of B&R components makes it possible.

Source: B&R

The DART-450 civilian aerobatic trainer has a maximum takeoff power of 500 horsepower, sidestick control and ejector seats.

An X20 system with several CAN bus adapters and other interface modules was used in the rear of the research plane to record sensor signals.

From left to right: Lars Peter (Technical University of Munich), Thomas Tholl (Diamond Aircraft) and Lucas Conditt (B&R)

Thomas Tholl
Group Leader – Automatic Flight Control Systems, Diamond Aircraft

"We chose B&R because their solution so easily supports future expansions to equip the measurement system for new tasks. The highly qualified local support teams always answer our questions quickly."

In the hangar of Austrian aircraft manufacturer Diamond Aircraft, the project team of the TUM Institute of Flight System Dynamics looks intently at the measurement data on the monitors in front of them. The research plane has just taken off from the runway and is now making its rounds high above. Since acquiring its research plane nearly eight years ago, TUM has conducted joint research projects here in the field of flight control. The aim is to apply the results to advanced aircraft design and find economical solutions that make flight control systems standard equipment for aircraft of all sizes.

Passionate pioneers in aviation

Diamond Aircraft was established as "Hoffmann Flugzeugbau" in 1981 in the Austrian state of Carinthia and has earned a reputation as a pioneer in its field. Approximately 1,200 employees around the globe, including 500 in Austria, work in the areas of general aviation, simulators, remote sensing and IT. The company has always pursued visionary goals to develop aircraft that meet the latest standards in technology, innovation, performance and design. Using fiber-reinforced plastic, for example, offers better surface quality and greater strength at low weight than traditional materials such as wood or metal.

Joint research project: TUM and Diamond Aircraft

Aircraft development and testing face increasingly demanding requirements in terms of instrumentation accuracy. The sophisticated avionics involved hardly fit in a university budget, which is why the project team started to develop its own measurement systems.

The technical requirements were clearly defined: simple "copy-paste-play" setup, a modular design and a wide variety of interface connections. It also had to be possible to record both digital and analog bus signals. "We chose B&R because their solution so easily supports future expansions to equip the measurement system for new tasks. The highly qualified local support teams always answer our questions quickly," says Thomas Tholl, group leader for automatic flight control systems at Diamond Aircraft.

The measurement system used during flight testing was also used to develop Diamond Aircraft's DART-450. The DART-450 is the first civilian aerobatic trainer in the world made entirely from carbon fiber and equipped with sidestick control and ejector seats. The dynamics of the aircraft, such as roll rates and accelerations, as well as aerodynamic parameters such as angle of attack and speeds were targeted for measurement.

B&R Automation PC 910 for data recording, routing and visualization

An Automation PC 910 was built into the university's research plane, which is used as the central data recording, routing and visualization point.

Multiple X20 systems with CAN bus adapters and other interface modules were installed in the rear of the aircraft to record sensor signals and forward them to the Automation

A seat was removed from the university research aircraft to make room for experimental systems and B&R technology.

While the research plane is in the air, flight data is recorded, analyzed and used to develop new algorithms.

PC 910. Around seven man-years have now been invested in the project, particularly in developing the software library and all additional functionalities.

The flight test system comprising a Automation PC and X20 modules proved to be an extremely flexible and cost-effective solution that not only records all the relevant sensor data and flight parameters, but also allows them to be viewed live during flight. The Automation PC preprocesses the data and forwards it on to a tablet computer, cockpit displays and even the ground control station.

The flight test system is also able to forward signals from the ground control station to the onboard control system in order to conduct remote aircraft control experiments in the development of unmanned aerial vehicle (UAV) technology. "The next step in the upcoming years will be to move towards digital flight control in the small aircraft sector," says project manager and TUM research associate Lars Peter.

Lars Peter
Project manager and research associate, Technical University of Munich

"We are very grateful to B&R for providing us with the devices we need free of charge. It's really fantastic and makes a huge difference in our project."

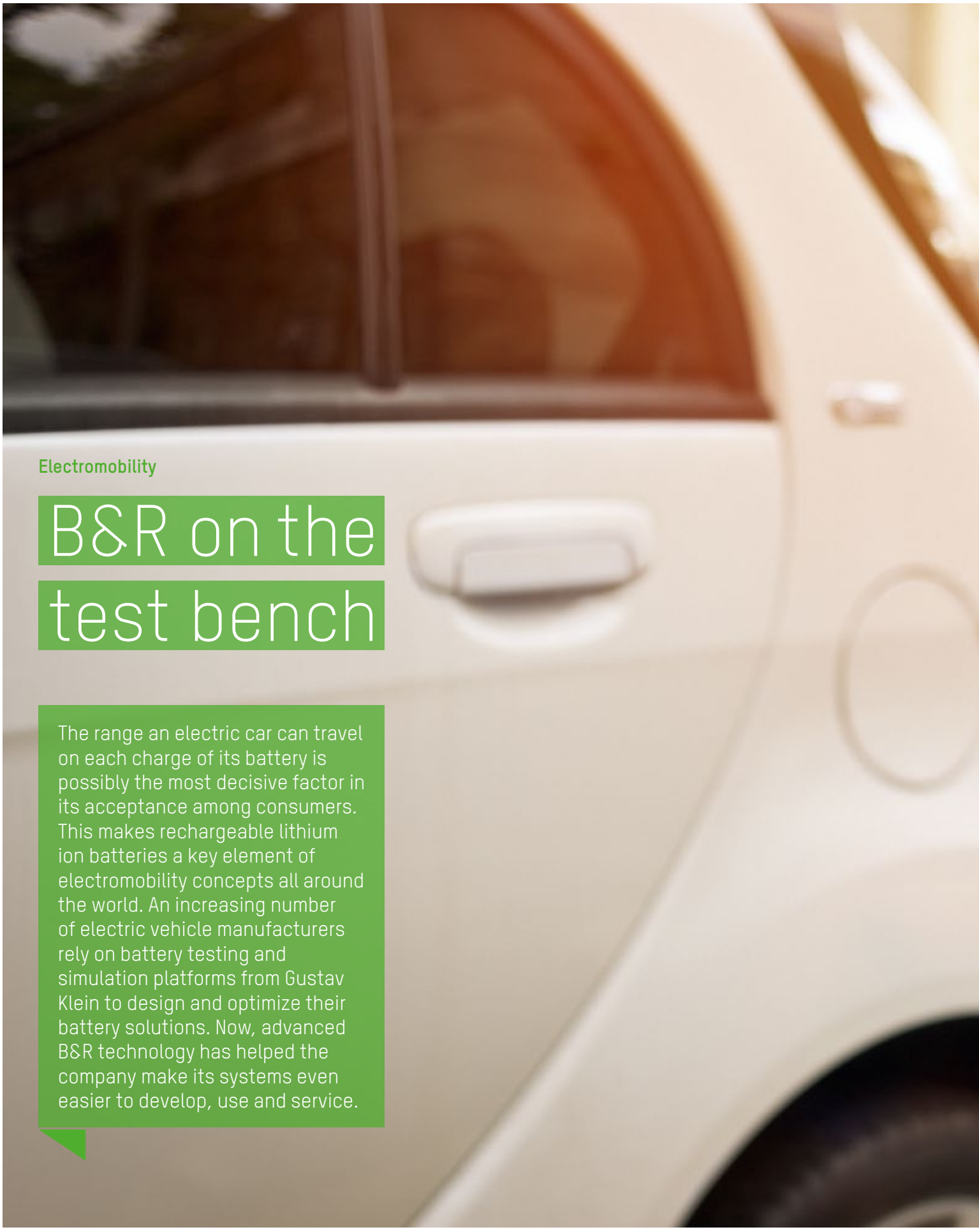
A balancing act between small aircraft and large-scale industry

The requirements of small aircraft and UAVs – namely high flexibility and speed in development – set it apart from those of large companies such as Airbus. Development of the DART-450, for example, took only 12 months from the initial model design to the first flight.

One of the main goals set by the project team is to make flight control a cost-effective option for small aircraft, so this was the primary focus of the measurement system research. "If a small aircraft costs around €1,000,000 – you can't have a flight controller that doubles the price. That would be a problem for the private aviation market," says Peter. "The situation is similar for UAVs: if the goal is to have more of them in the air taking on a growing range of civilian tasks, each one cannot cost €25 million."

Experimenting in this sector is a costly endeavor, however. The research equipment installed by the TUM project team in its research plane has already exceeded the value of the aircraft itself. "That's why we are so very grateful to B&R for providing us with the devices we need free of charge. It's really fantastic and makes a huge difference in our project," says Peter. ←

Sources: B&R, Diamond Aircraft



Electromobility

B&R on the test bench

The range an electric car can travel on each charge of its battery is possibly the most decisive factor in its acceptance among consumers. This makes rechargeable lithium ion batteries a key element of electromobility concepts all around the world. An increasing number of electric vehicle manufacturers rely on battery testing and simulation platforms from Gustav Klein to design and optimize their battery solutions. Now, advanced B&R technology has helped the company make its systems even easier to develop, use and service.

Source: iStock

Gustav Klein builds testing and simulation systems for the lithium ion batteries used in electric vehicles all around the world.

Germany has laid down the gauntlet for its automotive companies. By 2020, a million electric vehicles should be underway on the nation's streets and highways. As of January 1, 2017 the total was 34,022. Amid diesel scandals, impending inner city traffic bans and tightening restrictions on combustion engines in China and elsewhere – manufacturers are feeling the pressure from all sides to shift e-mobility into high gear.

"Things are really picking up momentum now," confirms Bernhard Rill, head of sales and marketing at Gustav Klein. Judging by the recent upsurge in interest among automotive manufacturers for the testing and simulation systems his company produces, Rill appears to be right. Automotive engineers use the Infeed Test System from Gustav Klein to assess the precise behavior of their vehicles' electrical systems and connected actuators under clearly defined and repeatable power supply conditions. "You can't do that with a real battery," explains Rill, "because of the constant fluctuations in charge level." Other uses of the Infeed Test System include the component testing performed during production of batteries and vehicles, or identifying the optimal power source for newly designed electric vehicles.

That's particularly easy with programmable test systems from Gustav Klein. Multi-channel variants are available with an internal DC bus that allows them to be combined as needed. This makes it possible, for example, to perform a controlled discharge on one channel and use the released power to charge a battery on the second channel. This simplifies the execution of charging cycles while at the same time reducing power consumption. "To accurately simulate battery behavior, you need a very rapid slew rate," says Rill. "Our systems make the jump from -900 to +900 amps in only 1.2 milliseconds, with a seamless transition between charging and output." Current systems are able to provide an output of up to 1,000 volts or 1,000 amps (up to 500 kilowatt capacity per device).

Product variety demands strategic shift

It's been fifteen years since Gustav Klein filled the first orders for its battery simulation and testing systems. Today, the company's products make their way from Schongau in southern Bavaria to the R&D and production facilities of nearly every major automotive manufacturer in the world. The more widespread the use, however, the more varied the requirements. "We have a huge variety of system configurations being used under drastically varying conditions," says Jörg Umbreit, head of R&D at Gustav Klein. "As a result, we have to support a growing number of interfaces and manage increasing product variation."

That places some challenging demands on the control system. The control loops need to run in the microsecond range in order to achieve the necessary slew rates. At the same time, the channels must be controlled with perfect synchronization to allow parallel operation. "The need to transfer large volumes of data further complicates the matter," adds Umbreit.

In the first evaluation phase, Gustav Klein looked at five well-known controls suppliers, with B&R coming out on top. "It was the total package that convinced us," reports Umbreit. "We were particularly impressed by the performance and flexibility of the system, the universal programming environment and the quality of the support we received. At a

With performance and reliability as top priorities, Gustav Klein puts every new development through its paces at its own testing lab.

personal level, things just clicked from the very beginning."

Flexible control architecture

In 2014, Gustav Klein's engineers began developing a new control architecture for the third generation of its Infeed Test System. For the control platform, Gustav Klein selected a rail-mounted CPU module from B&R's X20 system. "We were able to use an X20 controller with relatively little memory," says Umbreit. "As the requirements increase, the scalability of the B&R solution allows us to easily upgrade to a more powerful controller without having to make any changes to the software."

The new architecture also allows Gustav Klein to more readily accommodate its customers' interface requirements. An array of X20 interface modules are available for use with the CPU module.

The control system is operated using a remote Power Panel T30 terminal display. "Since the HMI application also runs on the rail-mounted CPU module, we're able to deliver the system without a display if needed," says Rill. "That helps us keep up with the trend of users operating their systems via remote access." Either way, the user interfaces are identical and only need to be programmed once.

Bernhard Rill
Head of Sales and Marketing, Gustav Klein

"Working with B&R is always productive, even when we approach them with complex questions or suggestions. Thanks to B&R, we now have a consistent, flexible and scalable automation system. The time and cost of integrating safety, control and HMI functionality has shrunk considerably."

One software project, one engineering environment

"One of the absolute highlights of the B&R solution is certainly the engineering environment – where we were able to create the HMI application and control software all in the same project." The same applies to the integrated safety technology, which is why Gustav Klein also decided to replace its separate safety hardware with integrated X20 safety technology. That decision further simplified engineering considerably.

The switch to B&R technology brought noticeable improvements in terms of variant management and maintenance as well. Gustav Klein is now able to manage its entire testing system, including all options and future extensions, in a single software project. "Whatever is not installed, we simply disable in the software," explains Umbreit. "That way we only have one software application to test and maintain for every release."

The very positive feedback from users of the new HMI and control technology have Gustav Klein planning to carry over the HMI solution to its largest product group: its power supply systems, which include UPS modules and mains inverters. ←

Heavy-duty offroad transport

Heavy loads, no roads

Source: Benzberg

When it comes to moving heavy loads efficiently over rough terrain, there's no substitute for an offroad dump trailer. These special-purpose vehicles can often be found working around the clock in remote areas. Upper Austrian manufacturer Benzberg has made it its mission to design and build especially rugged equipment for the industrial and civil engineering sectors. Together with B&R, they have developed a modular new controller that opens up exciting new potential applications.

From left to right: Bernhard Schmidthammer (B&R), Herbert Schneeberger (Benzberg) and Josef Joachimbauer (B&R) in front of a Benzberg dump trailer.

For customers in the heavy-duty offroad transport sector, the pain point is clear: There is not a vehicle on the market that can meet such challenging operational requirements under such extreme environmental conditions without extensive service and high maintenance costs. Benzberg founder and CEO Herbert Schneeberger realized this, and when the company reformed six years ago, his mission was clear: to design and build custom solutions for heavy-duty transport with a clear focus on the real-world needs of their users.

The Upper Austrian dump trailer manufacturer has its headquarters in the town of Schörfling am Attersee, as well as component production in Fornach and an assembly plant in Liezen, with approximately 65 employees in total. Nearly 70% of Benzberg's revenue comes from special-purpose vehicles, with the remaining 30% coming from dump trailers for civil engineering.

New B&R controller for heavy equipment

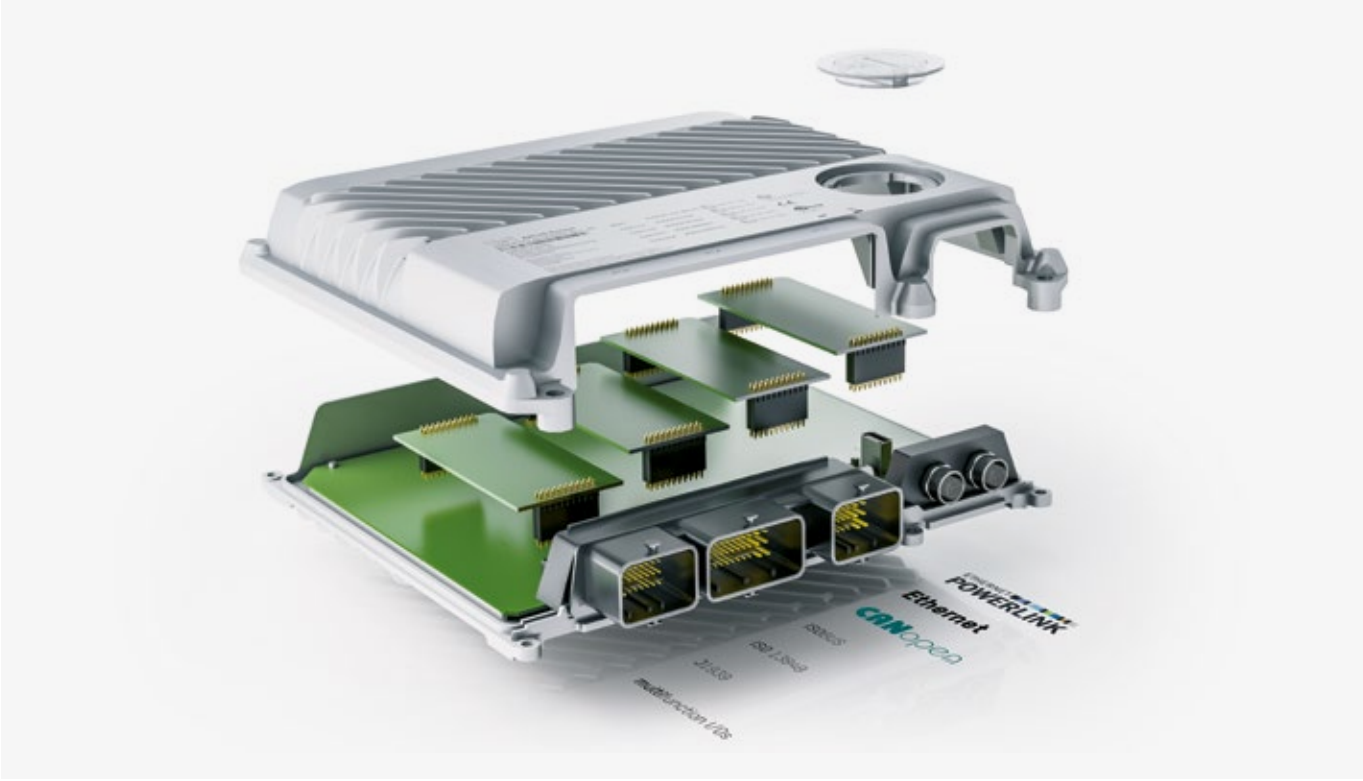
The challenges of harsh terrain, amplified by multiple-ton payloads, require specially designed axles and hydraulics systems. Together with trailer hitch manufacturer Scharmüller, Benzberg created a modular axle design that ensures driving comfort while at the same time maintaining stability and preventing rollovers.

To implement high-precision slope compensation, Benzberg sought a partner to build a new controller. "We were looking for an engineering partner we could build a new prototype with, and B&R came highly recommended," says Schneeberger. "After careful consideration, we decided to make the switch from our previous supplier. When collaborating on a joint project, geographic proximity is also especially important – and here, too, B&R was the perfect choice."

The joint project

The requirements for the new controller were clearly defined – the components would need to be modular, extremely robust and resistant to dirt, water and elevated temperatures. They would also need to be easy to maintain anywhere in the world. "It was a fascinating collaboration for us," recalls Bernhard Schmidthammer, sales manager at B&R. "As pilot customers, Benzberg and Scharmüller worked with us to develop a new product. It was a perfect combination that brought together a great deal of know-how from a variety of disciplines."

The project team comprised two engineers each from B&R and Scharmüller. Starting in December of 2016, they met every two weeks over the course of six months to ensure steady progress



The X90 module allows operators to continuously monitor the status of mobile equipment to maximize machine availability and save the considerable cost of outages and unplanned service calls.

through the step-by-step development milestones. After that came eight weeks of commissioning and around 3,000 hours of offroad testing, followed by two weeks to fine tune the programming based on the test results.

Conceptual design to series production

Slope compensation control is handled by the B&R X90 control system, operated from a touch screen display. The solution also features a weighing system and GPS monitoring. The weighing system displays the load volume and offers a considerable improvement in efficiency through more accurate invoicing and detailed reporting. GPS monitoring has become a standard feature on many construction vehicles. Not only does this allow them to be located, it also makes it possible to track their movement, record their hours of operation and define their service intervals.

"Construction of the prototype is complete – the remaining 10% involves the co-rotating drive axles," says Schneeberger. "At that point, we will have met all the targets we set at the beginning of the project and we'll be ready for series production."

The project was a fascinating challenge for everyone involved – which made all sides appreciate the successful cooperation that much more. "We were particularly impressed by the robust performance of B&R's products under such extreme conditions. Working with B&R was harmonious, productive and came very naturally. As a family business, the friendly atmosphere was very welcome," says Schneeberger.

Series production of the new dump trailer is set to start in 2018. By then all of Benzberg's 2, 3 and 4-axle vehicles will have the same software – ready for customers to configure their vehicles according to their specific requirements. ←

Herbert Schneeberger
Founder and CEO, Benzberg

"We were particularly impressed by the robust performance of B&R's products under such extreme conditions. Working with B&R was harmonious, productive and came very naturally. As a family business, the friendly atmosphere was very welcome."

Source: B&R

Interview

"Advanced development has a license to fail"

As a provider of high-tech manufacturing solutions, TRUMPF places great value on close cooperation with its suppliers. Bernhard Fischereder, head of development at TRUMPF Austria and Alexander Mayrböck, sales engineer at B&R, explain how collaboration between their two companies resulted in the world's fastest bending machine.

Mr. Fischereder, how did you first make contact with B&R?

Fischereder: A good ten years ago we set ourselves the goal of building the fastest bending machine in the world. We didn't believe that goal could be achieved with a traditional hydraulic drive system, so we began evaluating whether servo technology could give us the speed we were looking for. B&R was on our shortlist of suppliers that we looked at more closely.

Mayrböck: It was at a trade fair in 2005 that I was first approached by a TRUMPF developer – I remember it clearly. He showed a lot of interest in the torque motors we had in our portfolio back then. As it turns out, that would be the first of many meetings.

What got B&R onto your shortlist?

Fischereder: We recognized early on that B&R had a great deal of expertise to offer in the area of drive technology. The specialists we talked to provided excellent support in selecting and laying out the hardware.

Mayrböck: Funny enough, we now supply the machine's entire automation system. Everything, that is, except for the torque motor that started the whole conversation.

How did that happen?

Fischereder: B&R is a highly innovative company with a strong focus on developing and bringing new technologies to market. That philosophy harmonized very well with our ambition to build a state-of-the-art bending machine. So, we took a closer look at B&R's control systems, and eventually implemented the entire automation solution for the new machine using B&R controllers, I/O modules, drives and safety technology. The only thing that didn't go in B&R's favor was the torque motor. The reason for that is that we opted for an integrated spindle motor combination that wasn't available in B&R's portfolio.

How has the machine been received on the market?

Fischereder: Outstandingly. We presented it under the name TruBend 7000 back in 2008, and we're still producing it in high quantities to this day. In addition to speed and precision, that certainly has a lot to do with how much attention we paid to the machine's ergonomics. For example, the TruBend 7000 has a specially designed lighting system and also allows seated operation. Even now, it's still the fastest in the world.

Did that earn B&R a permanent spot as TRUMPF's controls supplier?

Mayrböck: For that machine, yes. But that didn't mean we would automatically be chosen for future projects. TRUMPF wants to be sure it is building the best machines possible for its customers, so it evaluates suppliers according to the specific requirements of each project.

Fischereder: We follow a very clearly defined benchmarking process to evaluate and select potential suppliers. The criteria on which we base our decision vary from machine to machine. If we look at our next development project, the TruBend Cell 7000 – there we had very special demands in terms of robotics. Rather than a separate proprietary controller, we wanted to have the robotics directly integrated in the machine controller. We also evaluated each supplier's closed-loop control technology, costs, general development risk, capacity for innovation and countless other factors.

Mr. Mayrböck, what was this benchmarking process like from your perspective?

Mayrböck: TRUMPF certainly didn't make it easy for us – the technical specifications were quite imposing. But, while a selection process like this is never easy, in the end we benefited a lot from it. Solving TRUMPF's requirements led us to integrate a variety of new functions into our system that continue to give us a clear advantage on the market. For example, as one of the first customers to use our fully integrated robotics solution, TRUMPF provided valuable feedback. As challenging as implementation was back then, B&R has been enjoying the benefits

of fully PLC-integrated robotics ever since. And, we have TRUMPF and its uncompromising requirements to thank for that.

Fischereder: That really is a good snapshot of how TRUMPF and B&R work together in general. We're both technological pioneers and set ourselves ambitious goals. Rather than passively selecting from B&R's existing portfolio, we're actively engaged in a mutual process of continuous development. And ultimately, that process benefits both sides.

What does it mean to be a technological pioneer?

Mayrböck: Mr. Fischereder, if you'll allow me to use your company as an example: TRUMPF is on a never-ending search for ways to improve its products. When a new technology hits the market that TRUMPF thinks might be interesting, they have a special department dedicated to creating functional prototypes based on that technology.

Fischereder: Exactly right. Our advanced development department allows us to pursue completely new ideas parallel to our daily business, which is extremely valuable. Frequently, this phase involves cooperations with universities. In fact, it was a member of our advanced development team that approached Mr. Mayrböck about torque motors that day at the trade fair.

What happens after advanced development?

Fischereder: That depends. Since they're exploring topics that are completely new to us, our advanced development team has a license to fail. They are tasked with testing the viability of new ideas, and if they didn't have the freedom to fail, there are some things they would hesitate to try. If we reach the end of an advanced development project and there are too many risks or unknowns, we pull the plug. If the technology proves itself, then we continue on with a full-fledged series development project.

What are some new technologies that TRUMPF has introduced?

Fischereder: Two examples that have made it into series machines are variable-speed servo hydraulics and multi-touch HMI – both of which can be found in our newest press brake series, the TruBend 5000. For the control and drive technology on these machines, we once again chose B&R.

Mayrböck: After an exhaustive benchmark evaluation, that is. TRUMPF again demonstrated its commitment to understanding the exact needs of its customers and then developing solutions to meet them. For example, we had to present a whole selection of operator panels with different touch sensor technologies. They put each one through its paces in terms of durability, image quality and suitability for gloved operation.

So it's fair to say you have an eye for detail, Mr. Fischereder?

Fischereder: A machine is only as good as its ability to meet the customer's needs. That comes down to the big things like performance and production quality, but also the little details like ergonomics. In the end, it's the combination of all these factors that makes our machines so successful. ←

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Overall Equipment Effectiveness (OEE)

Industrial IoT for brownfields

As a comprehensive performance indicator, overall equipment effectiveness (OEE) can play an important role in making manufacturing assets more productive. Difficulties gathering the data needed to calculate OEE, however, have often prevented it from being used to improve older brownfield systems. Now, there is a solution that lets you easily tap into the operating data of digitally isolated equipment and benefit from automated acquisition, harmonization and analysis – including real-time OEE monitoring.


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Source: B&R

Overall Equipment Effectiveness (OEE)
Overall Equipment Effectiveness (OEE) is a key performance indicator used to track the productivity of manufacturing assets. The three underlying factors used to calculate OEE are the ratios of good units to total units (quality factor), production speed to designed speed (performance factor) and actual uptime to scheduled production time (availability factor). Fully optimizing one of these factors – achieving zero unplanned downtime, for example – would result in a 100% rating for that factor. Multiplying the three factors gives you the OEE value.

Since there is no universally accepted method for defining the optimum level for each factor, comparing OEE ratings across different lines or facilities only makes sense if the factors are calculated consistently.

Connected manufacturing systems with access to the latest technology are able to collect and evaluate extensive technical and operational data to implement the type of solutions envisioned for Industry 4.0 and the Industrial Internet of Things (IIoT). It's easy to expect these features from a greenfield project when starting more or less from a blank slate. For the majority of plant managers, though, the reality is a bit more complicated.

"A company can't just tear down all of its facilities and start from scratch," says René Blaschke, B&R's expert for IIoT brownfield integration. When retrofitting legacy equipment to support new Industrial IoT solutions, the first step is to find a way to automate the collection and harmonization of its operating data. Then, you need to use this data to calculate the OEE, which reveals productivity losses and serves as the foundation for improving overall performance.

Automated data acquisition from brownfields
To this day, it is not uncommon to find machine operators scribbling down operating data with a notepad and pencil. "This data then lands on the desk of an analyst for processing," says Blaschke. Not only is this a far cry from the digital-age ideal of real-time analytics, it is unrealistic to expect every shift to record its data in a consistent, standardized way. "This has been a notorious problem in production data acquisition," notes Blaschke. It also makes it very difficult to compare performance across different machines.

Industrial manufacturing equipment has a particularly long service life. With machines typically running for 25 or 30 years, one that was installed 15 years ago can easily be around for another decade. For a company looking to implement Industry 4.0, that is simply too long to wait. "So, what you need is a way to bridge the gap for the remaining service life of brownfield equipment," says Blaschke.

For plant managers, this means finding a reliable way to collect and analyze data from machinery and equipment that otherwise lacks the necessary connectivity. With its new Orange Box concept, B&R has proven that doing so can be surprisingly easy. "An Orange Box can substantially reduce downtime and boost the availability of existing machines and lines," says Blaschke. "That makes your entire operation more productive and profitable."

Smartphone notifications
The Orange Box can notify machine operators of significant events – like an open safety door – directly on their smartphone. This allows them to react immediately and resume production as quickly as possible. When the frequency of unplanned stoppages is clearly documented, it becomes obvious where targeted improvements can be made.

Further potential for improvement can be identified by comparing productivity between machines, lines or shifts. "Very often, relatively minor adjustments can have a dramatic impact on productivity," reports Blaschke. Better synchronizing maintenance and break times is a perfect example.

Straightforward technology
From a technical standpoint, the Orange Box concept is remarkably straightforward. A B&R controller reads operating data either via wired I/O channels or directly from the machine controller using communication protocols. The Orange Box reads data from B&R, Siemens or Rockwell controllers via the respective INA, ISO on TCP or EtherNet/IP protocols, converts it into OPC UA messages and processes it.

"The results – such as the OEE value – can be displayed right on the machine and/or passed on to higher-level systems," explains

The Orange Box provides a clear overview of operating data for any manufacturing asset.

An Orange Box can transform a production line plagued by frequent unplanned stoppages (left) into one where downtime is a rare exception.

Blaschke. The Orange Box has an OPC UA server that allows any manufacturing execution system (MES) or enterprise resource planning (ERP) system to access the data. When used as an edge device, the Orange Box is also able to send data into the cloud.

The right mapps for your solution

"For the Orange Box to deliver the greatest possible benefit," recalls Blaschke, "we knew it would have to be easy to set up and easy to use." That's why the solution is built around the modular software components of mapp Technology. mapp components – or "mapps" for short – are preprogrammed to exchange information automatically. "Configuring a mapp component is no more difficult than setting up an email account."

A few quick settings, and mapp OEE is ready to start delivering a machine's OEE data, for example. "There's no need to write a single line of code," emphasizes Blaschke. mapp OEE has an accompanying HMI component that works in the background. Together with mapp View – B&R's HTML5-based HMI solution – this component can display real-time content on any web-enabled device. The intuitive dashboard provides an at-a-glance overview of all the most important information.

Pay-per-use

Orange Box is not a traditional product, but rather a conceptual solution shaped by the unique needs of each customer and machine. Its specific functions can be tailored on demand simply by adding the appropriate mapps. Set up an alarm system with mapp Alarm, for example, and use mapp Tweet to alert machine operators of relevant alarms via email or text message. Industry standards such as PackML are also neatly packaged in mapps for easy integration into the Orange Box.

"As a customer, you can pick and choose exactly the functions you need," says Blaschke. "And, like apps on a smartphone, those are the only ones you pay for." The software management functionality provided by the mapp Technology platform allows Orange Box users to install updates or new mapp components via LAN, WLAN or USB flash drive.

Shaped by customer requirements

The Orange Box's modular software is complemented by its equally modular hardware. The most compact form features a 25-millimeter-wide compact controller. "That and mapp OEE are all you need to collect the necessary data and calculate OEE for a machine," explains Blaschke. For more advanced features – such as alarm management or energy monitoring – the solution can easily be scaled up with more powerful controllers and additional software components. Customers who want to give the Orange Box a modern user interface as well can add an operator panel with an integrated controller or a panel-mounted PC unit.

"All the hardware and software is completely interoperable," notes Blaschke. Plant managers can use different combinations of hardware and software on different machines with no added overhead. The Orange Box quickly and painlessly lifts brownfield equipment out of digital isolation to enjoy all the benefits the age of Industrial IoT has to offer. ←

René Blaschke
Expert – Industrial IoT for Brownfields, B&R

"Orange Box helps increase the availability of machinery and equipment."

Author: Carmen Klingler-Deiseroth, freelance journalist

openROBOTICS

Handling robots with ease

It's hard to imagine a modern automated production line without flexible workpiece handling. That's why OEMs like HB Systems are increasingly incorporating robots into their solutions to perform pick-and-place operations. With mapp Technology and openROBOTICS from B&R, doing so has never been easier. Robotics functions can simply be incorporated into PLC programs without any separate robot controllers or specialist training. This is demonstrated perfectly by the workpiece handling solution on a threading machine from HB Systems.

The pick-and-place task performed by the SCARA robot on the HB Systems threading machine is similar to those found in many machining and assembly lines. The position and angle of a newly received workpiece – in this case a pressed sintered metal component – are captured by camera and sent to a robot. The robot picks up the piece and maneuvers it into the correct position at the machining station.

At first glance, there's no outward indication of the innovative technology at work behind the scenes – technology that could revolutionize the way OEMs think about robotics: B&R's mapp Technology and openROBOTICS.

HB Systems is one of the first OEMs to integrate an openROBOTICS robot from COMAU for pick-and-place tasks.

"In the past, we too have taken a very conventional approach to pick-and-place: we selected a robotics supplier and used their tailor-made control hardware," says Hans Bögelein, founder and CEO of HB Systems. "We out-sourced the robotics programming so that we could concentrate fully on our core competency: designing automation solutions and inspection systems."

It's a reasonable decision, and one that many other OEMs have made in the past. Ultimately, implementing a robotics application requires extensive expertise and personnel with special training to use the robot manufacturer's development tool. This has often been a burden on small and medium-sized OEMs' financial and human resources, effectively forcing them to go the outsourcing route.

A combined hardware and software platform

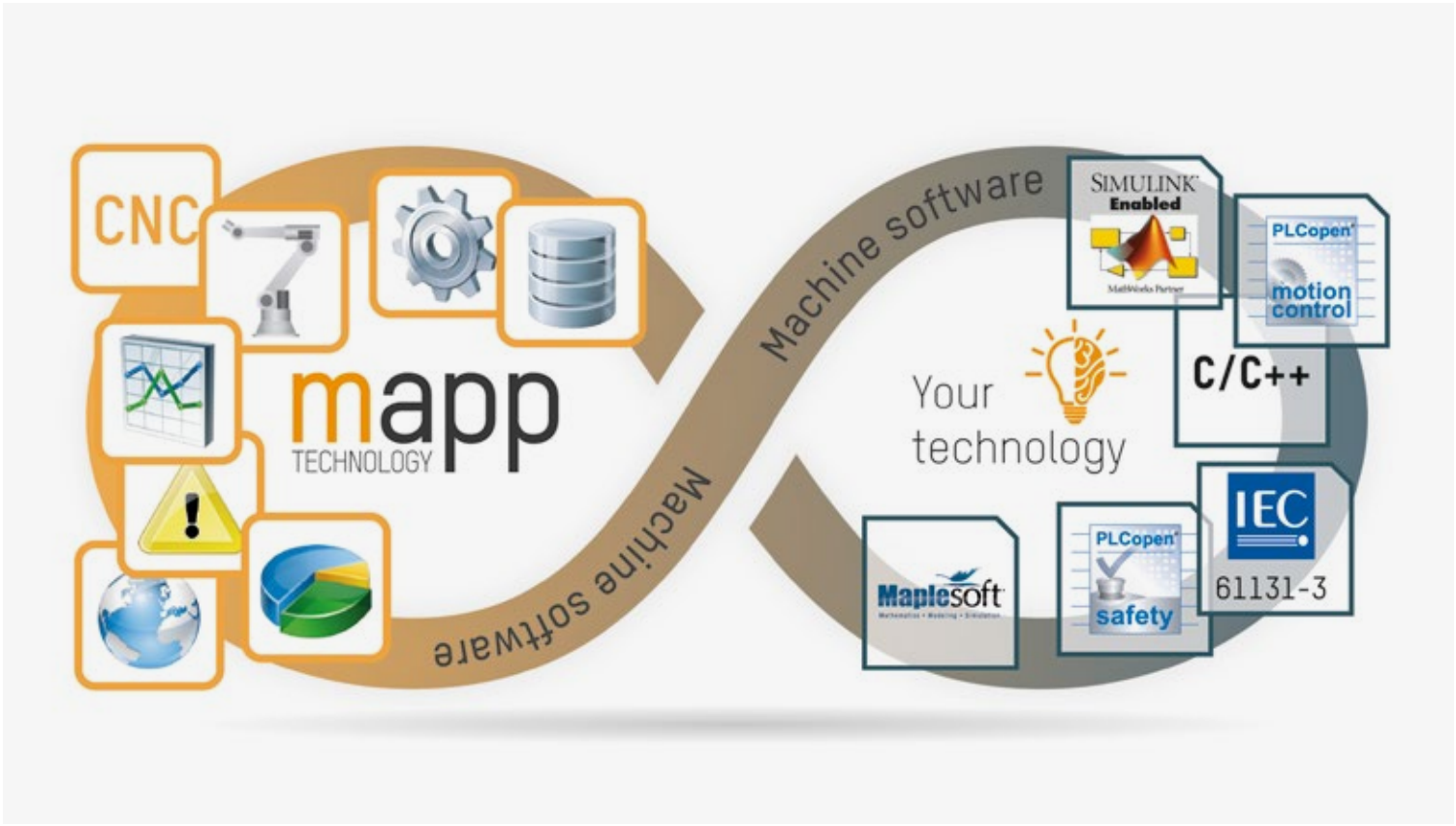
Now, B&R and the robotics experts at COMAU have dealt OEMs an entirely new hand by creating openROBOTICS, which – for the first time – unifies robot and machine controllers on a combined hardware and software platform.

"The biggest advantage from our perspective as a PLC-oriented company, is that we can develop the robot application within our familiar engineering environment, Automation Studio, along with everything else. That means we can make any required changes to the robot functionality much faster and more flexibly than before," says the CEO, explaining the decision to use openROBOTICS.

B&R has developed a corresponding mapp component that relieves the user of tasks such as configuring the robot geometry, identifying the right transformation, coupling axes or tuning the servo drive. Handling tasks can be implemented without writing a single line of code.

Dipl.-Ing. Hans Bögelein
Founder and CEO, HB Systems

"Thanks to openROBOTICS and mapp Technology, we have been able to integrate robot functionality into our system software for the first time – in-house and with a manageable workload – and can further develop it and perform diagnostics without ever having to leave our familiar engineering environment. This makes us even less reliant on third parties and gives us added flexibility in how we design and maintain our systems."



B&R mapp Technology is revolutionizing the development of application software in the field of automation. The modular software blocks simplify development of new programs and reduce the development time for new machinery and equipment by an average of two-thirds.

Robot integration in just a few days

"We implemented the robotics functionality for our threading machine on our own in just a few days," says Bögelein. From placing the order for the automation components to commissioning the new machine, the whole process took just six weeks. Since then, it's been running as an inline system for an automotive supplier.

One reason for the rapid completion of the project was the decision to use mapp Technology to create a robotics application that integrates seamlessly into the rest of the application software. This allowed the OEM to continue using leveraging the collection of Structured Text modules it had been building over the years. Long latency times for communication via fieldbus or cable between sequential and robot controllers were avoided, making it easier to synchronize the two and achieve greater positioning precision.

Minimal engineering and hardware costs

Thanks to openROBOTICS, the COMAU robot's control electronics are an integral feature of the B&R system landscape: just like every other axis in the system, the motors of the SCARA robot arm are controlled by ACOPOS servo drives using a common DC bus. As a result, braking energy can be recovered and fed to other motors throughout the system to both save energy costs and improve the CO_2 footprint.

The openROBOTICS approach also has positive effects on hardware costs. Sequential control, robotics control and the HMI application all run on a single hardware platform, eliminating the need for a separate robot controller and display.

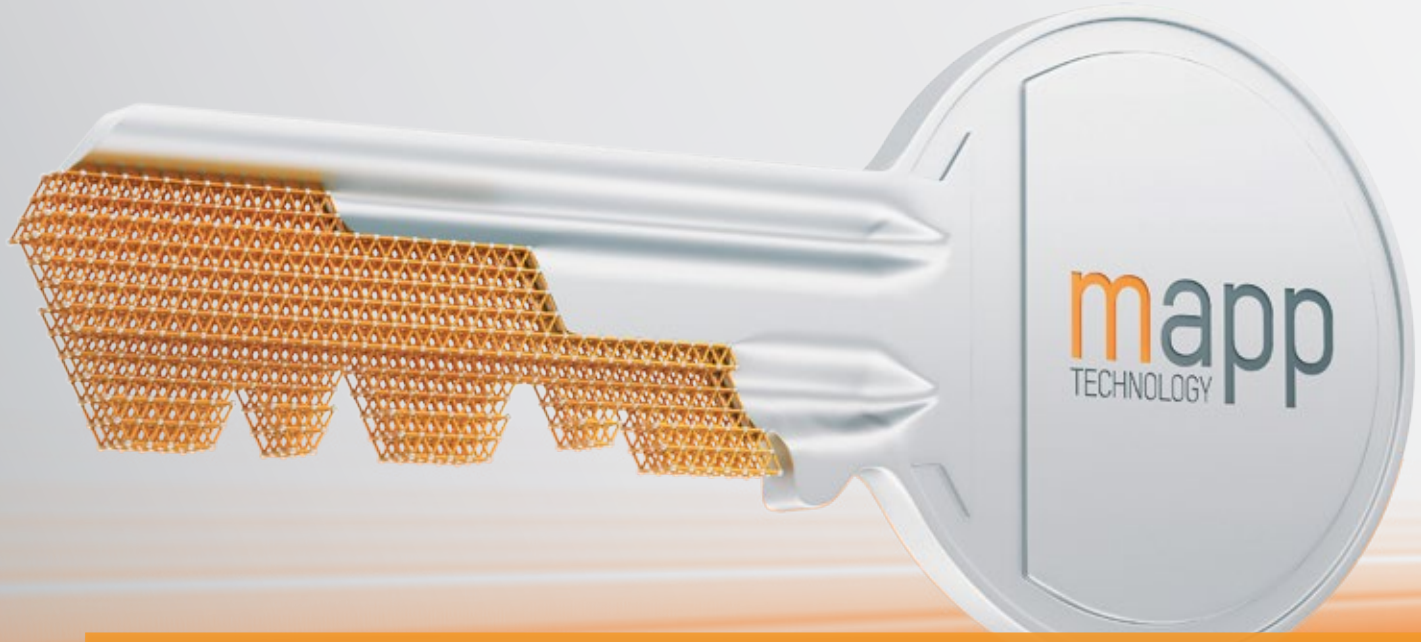
Integrated automation

For HB Systems' threading machine, an Automation PC 2100 is able to handle all the applications, with the HMI application displayed on a Power Panel T30 terminal. The image processing system – which is supplied by KEYENCE, as is the camera – is integrated via Ethernet/IP using an X20 interface module from B&R. HB Systems' fully integrated automation solution uses modules from the X20 lineup for communication throughout the production line, including modules providing integrated safety functions.

In addition to simplifying the process of engineering the control, HMI and safety applications, having all the main automation components so tightly integrated pays off in terms of diagnostics as well. Since they have direct access to axis errors and other alarms without having to go through external systems, for example, machine operators are able to identify the location and cause of a problem faster.

"Thanks to openROBOTICS and mapp Technology, we have been able to integrate robot functionality into our system software for the first time – in-house and with a manageable workload – and can further develop it and perform diagnostics without ever having to leave our familiar engineering environment," says Bögelein. "This makes us even less reliant on third parties and gives us added flexibility in how we design and maintain our systems." ←

Sources: HB Systems, B&R



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Automatic control loop tuning

mapp Hydraulics software components provide convenient access to advanced closed-loop hydraulic functions.

New software components for easy hydraulics control

B&R is introducing new software components for controlling hydraulics applications. These components provide easier access to advanced closed-loop control functions and assist developers in the design, simulation, virtual commissioning and diagnosis of hydraulic systems. B&R mapp Hydraulics provides numerous new functions, particularly for variable-speed pump drives.

Automatic control loop tuning

With the autotuning function, the system automatically optimizes the control loop parameters for the hydraulic pressure controller. This boosts both quality and system performance. Optimized pressure control parameters also help prevent damage caused by overloading or cavitation.

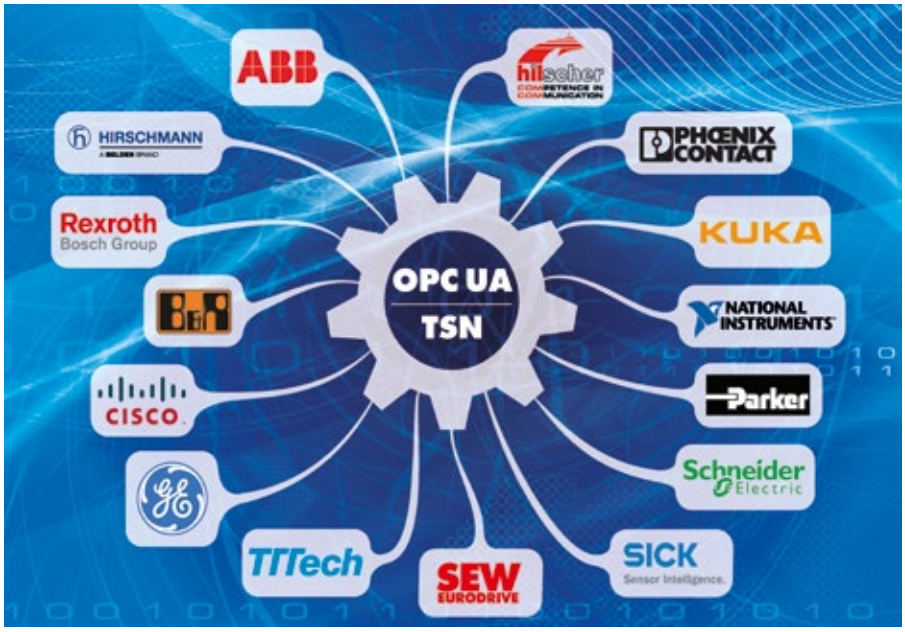
If autotuning is used during operation, the machine software can automatically recalibrate the controller following changes to environmental conditions or other factors such as load forces or characteristics.

OPC UA TSN

Welcome to the age of plug-and-produce

Large real-time industrial communication networks pose serious challenges for their operators. As the number of nodes grows, so does the complexity and cost of the engineering involved. These challenges are frequently compounded by the need to integrate a heterogeneous protocol landscape. The extension to the Ethernet standard known as Time-Sensitive Networking (TSN) in combination with OPC UA promises substantial improvement. A number of testbeds are currently underway testing implementation of OPC UA TSN.


...goes real time



The shapers of OPC UA TSN development are collaborating to bring a fully interoperable solution to market.

For a decade and a half, industrial manufacturing has relied on a variety of proprietary Industrial Ethernet protocols for fast, reliable communication. During this time, operators of plants and machinery have all too often faced the task of integrating a hodgepodge of protocols into a comprehensive network. "It's an extremely time-consuming, cost-intensive undertaking," says Sebastian Sachse, technology manager for open automation at B&R. "It would be so much easier if all the machines simply spoke the same language."

In addition to disparate protocols, producers must also contend with a rapidly growing number of network nodes. Configuring a large real-time network is a laborious process that can quickly push engineering tools to their limits. As we begin to see implementation of the Industrial Internet of Things (IIoT), networks with hundreds of fieldbus-level nodes will become increasingly common.

The Industrial Internet Consortium

In March of 2014, five companies – AT&T, Cisco, General Electric, Intel and IBM – came together to form the Industrial Internet Consortium (IIC). Among the non-profit's objectives is the definition of reference architectures and frameworks that will make interoperability possible.

One of the main topics addressed by the IIC is the Industrial Internet of Things. Other areas include healthcare, transportation and finance. Rather than develop standards itself, the IIC cooperates with organizations such as the IEEE, IETF, AVNU Alliance and the OPC Foundation.

The TSN testbed

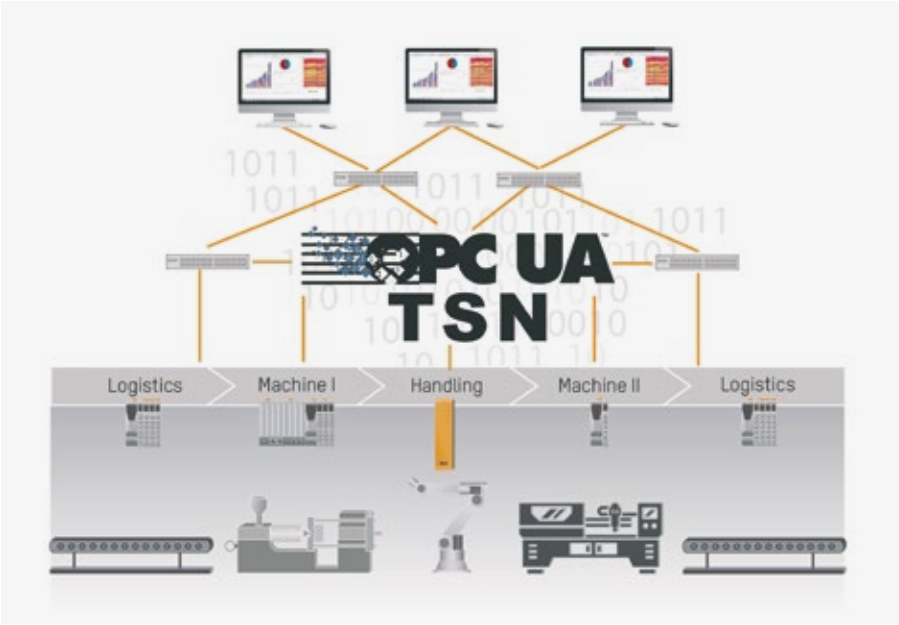
"In terms of the Industrial IoT, there is one aspect of the IIC that is particularly interesting: the TSN testbed," notes Sachse. "What we need is a technology that makes machine and plant networks more modular, flexible and easier to work with – and the market is largely unanimous that OPC UA TSN is that technology." While OPC UA development is driven by the OPC Foundation, the IIC is heavily involved in TSN implementation.

B&R recognized the potential of TSN early on, leading them to join in the IIC's efforts. "The consortium was the first organization to begin testing TSN under real-world conditions," explains Sachse. Since then, the automation specialist has been helping advance the technology through its participation in the TSN testbed, evaluating the interoperability of its OPC UA TSN prototypes with those of other members. As of May 2017, that includes: B&R, Bosch Rexroth, Schneider Electric, National Instruments, Kuka, Sick, Cisco, Intel, Belden/Hirschmann, Hilscher, Renesas Electronics, Analog Devices, TTTech and Xilinx. Other participants include: Calnex, Ixia, ISW Stuttgart University and Phoenix Contact.

Successive testing of core TSN capabilities

TSN is an extension of the Ethernet standard and brings a number of improvements that will give Ethernet real-time capability. The testbed members successively tested three core capabilities in particular: time synchronization, traffic scheduling (precisely timed sending of data packets and frames) and automated system configuration with a central network configurator (CNC).

A fundamental requirement for implementing TSN for real-time industrial communication is time synchronization in accordance with 802.1AS-Rev. This TSN standard includes definitions of the Precision Time Protocol (PTP), which synchronizes the clocks of all devices in the network. In the test setups, PTP exceeded expectations by achieving a precision of under 100 nanoseconds.



OPC UA TSN makes machine and plant networks more modular, flexible and easier to work with.

The second core TSN capability evaluated in the testbed's plugfests was scheduled transmission of data packets and frames as outlined in IEEE 802.1 Qbv. A Time-Aware Scheduler ensures that time-critical data is always prioritized so that it is not blocked by general network traffic.

Dynamic configuration

The network used in initial plugfests had a static configuration. Current tests are now examining dynamic configuration as defined in IEEE 802.1 Qcc. When a new device is added to the network, it registers itself with the central network configurator, which establishes a connection with other devices and reconfigures the network accordingly.

The individual elements of TSN work together perfectly – not just in theory but also in real-world testing – and will enable real-time communication using standard Ethernet components. The TSN testbed currently consists of two setups – one is located at National Instruments in Austin, Texas and the other at Bosch Rexroth in Erbach, Germany. In April of 2017, the German association Labs Network Industrie 4.0 (LNI 4.0) announced plans to establish its own TSN testbed in cooperation with the Mittelstand 4.0 competency center in Augsburg.

Sebastian Sachse
Technology Manager – Open Automation, B&R

"What we need is a technology that makes machine and plant networks more modular, flexible and easier to work with – and the market is largely unanimous that OPC UA TSN is that technology."

Mittelstand 4.0 is a German initiative created to support the digital transformation of Germany's small and medium-sized enterprises.

The team envisions a mobile demo that can be transported by truck. Though their approaches differ, the IIC and LNI 4.0 share a common goal: 100% interoperability. Collaboration between the two initiatives is already in planning. B&R will also be participating in the LNI testbed.

Plug-and-produce

"The IIC testbed clearly demonstrates how innovation cycles are growing shorter," says Sachse. Preparations for the testbed began only two years ago, and the first core capabilities have already reached technological maturity. "For a completely new technology that is astoundingly fast."

The market is undergoing a fundamental shift. Traditionally, control system suppliers have sought to differentiate themselves by means of their communication technology. "Those days are gone," says Sachse. OPC UA TSN will serve as a uniform standard for seamless communication above the controller level.

With the newly gained interoperability, commissioning will involve little more than simply plugging in the network cable. "Welcome to the age of plug-and-produce," smiles Sachse. ←

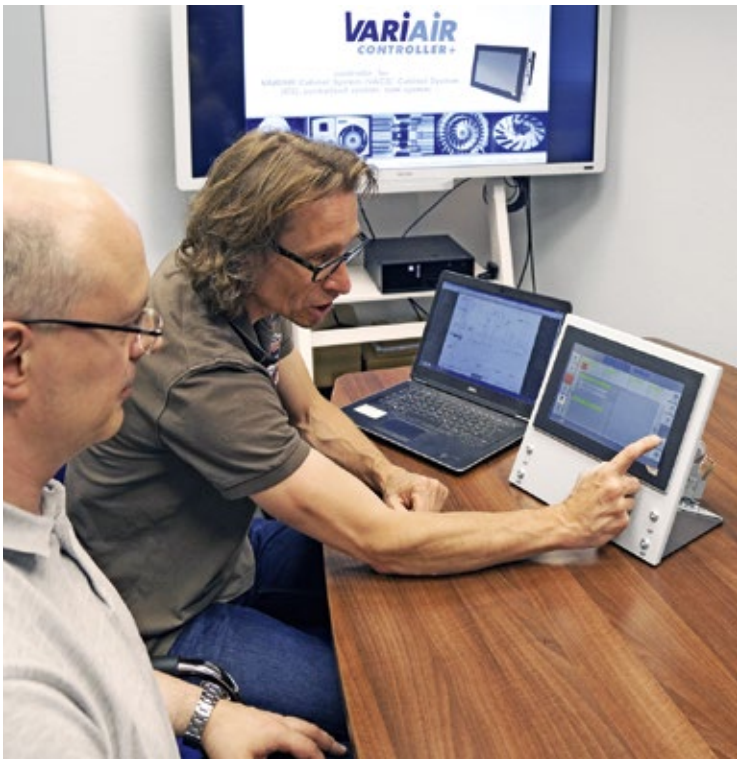
Air supply systems

An air of innovation

From printing and packaging to woodworking and wastewater treatment – nearly every industry relies on the power of blown air and suction to perform key technological functions. The potential uses for moving air are diverse, and so are the requirements placed on the vacuum pumps and compressors that move it. How well these supply systems match the needs of their users determines not only the stability of the process and the quality of the end product, but also important factors like energy efficiency and customer satisfaction. These challenges are no problem for Becker, whose scalable VARIAIR Controller+ features a new standardized BECKER control panel based on B&R technology.

Source: iStock

This central air supply system provides suction and blown air for multiple production lines in an energy-efficient way.



During meetings with its customers, Becker is able to configure a perfectly customized solution on the VARIAR CONTROLLER+ test system and simulate its user interface.

Energy is a cost driver for most manufacturing companies. This is in large part due to the units that supply suction and blown air to various steps throughout the packaging process – from handling to vacuum packing. Although modern compressors are relatively energy efficient, the sheer number of individual units and lack of coordination between them are responsible for the high energy consumption.

Intelligent systems for high energy efficiency

Well aware of this problem, Becker has over 800 employees worldwide working to create custom tailored solutions for energy-efficient compressors and air supply systems. These mainly include flow-optimized vacuum pumps as displacement and flow machines. "The value we offer goes beyond our innovative devices and systems," says Stefan Beierlein, head of product management and marketing at Becker. "What's much more important is that the solutions are perfectly tailored to our customers' needs. These systems can only be energy efficient if they're able to closely follow a constantly changing operating point." Even greater efficiency gains can be achieved when the air supply is coordinated and controlled centrally

Stefan Beierlein
Head of Product Management & Marketing, Becker

"The ability to manage everything in a single software project and perform text-based configuration have given us a major competitive edge in terms of both productivity and customer satisfaction."

One control software for all devices and systems

To carry out this task and implement new ideas, Becker developers began the search for an automation system that would be future proof and, above all, modular. "Our goal was to cover all possible variants of our system with a single software project. That would give our developers the freedom to work on new functions instead of constantly building new customer software," says Project Manager Ralf Trinler. At the same time, Becker was looking for ways to streamline its entire project workflow – from the initial customer meeting through production, commissioning and service. "We were won over by the B&R system from the outset. The availability of text-based configuration for the application software in B&R Automation Studio would allow us to meet all of our goals," says Trinler.

Via an additional system access point, it is also possible to view and operate the HMI application on tablets.

One hardware unit for control, configuration and simulation

The results speak for themselves. The VARIAIR Controller+ features a Power Panel C70 and a variety of X20 I/O modules and can communicate directly with vacuum pumps and compressors of all sizes. Sophisticated control software from Becker ensures efficient operation and all relevant data can be stored so that on-site service technicians are always informed of the current configuration and system status. The array of optional interfaces offered by B&R enables direct communication with virtually any customer system. Trinler is particularly proud of another highlight: "Now, when our engineers sit down with the customer to determine their requirements, they are able to configure and simulate a perfectly tailored solution right there on site."

Three HMI applications running in parallel

In order to achieve this, the developers took full advantage of the opportunities for modularization built into the B&R system. In addition to the control program itself, they created separate software modules for configuration and simulation and grouped them all together in one software project. The HMI applications for the three modules can be viewed either on the Power Panel C70 or one of two WLAN-connected tablets. Without leaving the customer's side, the system configuration file and final HMI application can be generated with a few clicks of the mouse. Following this with a simulation gives the customer a live experience of future user interface.

Efficient production through text-based configuration

With the push of a button, the entire system configuration laid out in consultation with the customer is saved in the B&R as a text file. The system configuration file and the main control application are stored on a central server that can be accessed from anywhere in the world. Prior to delivery, the system data is loaded directly from here onto the VARIAIR CONTROLLER+ along with the main control software – without any additional programming. Any adjustments to the system that become necessary later on can be performed by engineers on site without outside assistance, documented and returned to the server.

The company is well equipped for the future. Without any changes to the core software, the Power Panel C70 can easily be replaced by an X20 Compact CPU. In a further stage of development, operation can alternatively be carried out using a wireless tablet. "The interoperability of B&R's hardware and software and their global availability give us all the freedom we need to implement future projects," praises Trinler. ←

Interview

"For the user, standardized means future proof"

POWERLINK has been adopted by the IEEE under international standard IEEE 61158. It is the only Industrial Ethernet protocol to achieve this status. We asked Dietmar Bruckner, technical manager of open automation at B&R, to describe the standardization process and explain what advantages we can expect to come out of it.

Why is it significant that POWERLINK has been standardized as IEEE 61158?

It's a differentiating factor that will further accelerate the spread and acceptance of POWERLINK. It makes implementation easier and cheaper. At the same time, it reminds us that Industrial Ethernet continues to gain significance. In the age of Industrial IoT and Industry 4.0, real-time communication is becoming more and more important.

What sets Industrial Ethernet apart from regular Ethernet?

Two things: determinism and semantic context. Working at our office PC, connected to a fast IT network, we may get the impression that we're sending and receiving data more or less in real time – but that's not the case. Whenever you have large numbers of simultaneous requests or large files being sent, the network may get sluggish or even crash. That can be frustrating, but it's not the end of the world. In an industrial setting, network congestion can cause much bigger problems.

Like what?

Imagine an automotive assembly line with a robot that mounts the windshield onto the chassis. There are sensors that tell the robot how much farther to move until the windshield is in the right position. If the signal telling the robot to stop is delayed by just a second, or if the robot doesn't understand the semantics of the message, you're cleaning up a broken windshield. If a human operator is nearby, the consequences can be even more serious. That's why it is imperative that all the data needed to control a machine is guaranteed to arrive at a clearly defined time and that it is understood by every node in the network.

How do you do that?
There are a number of mechanisms involved. The network nodes all need to be on the same page with regard to timing and data types, for example. This and many other functions are what's provided by the Industrial Ethernet protocols.

Which brings us back to POWERLINK. How did it come to pass that POWERLINK is standardized by the IEEE?
For a long time, real-time communication was uncharted territory for the IEEE. That's why, in 2014, I started pushing for the IES to address the topic. IES stands for Industrial Electronics Society – it's a subgroup within the IEEE, the world's largest professional organization for electrical and electronics engineers. The IES sponsored a working group within the IEEE tasked with adopting a standard for real-time communication.

How does a working group like that operate?
We had 38 participants from all over the world – representing everything from industrial companies and consulting firms to universities and research institutes. We introduced a draft for the specification, and it was discussed exhaustively. But, the IEEE sets very strict criteria for new standards. Not only the technical content, but also potential conflicts with other IEEE standards, structure, formatting, even spelling and punctuation – were all checked, rechecked and fine tuned.

Were any protocols other than POWERLINK evaluated?
No. The working group was very quickly in agreement that POWERLINK satisfied the requirements of the IEEE perfectly. Not just because of its excellent technical qualities, but also the fact that it is 100% compatible with the Ethernet standard. As open source technology, POWERLINK also doesn't have any proprietary rights to deal with.

When did the working group complete its evaluation?
There were several steps involved. First, we had a number of rounds of discussion and voting within the group. A group was formed within the IEEE itself to conduct two rounds of voting on technical matters. Then the development process itself and the formal requirements were examined. This is a clearly defined process within the IEEE, and occurred over the first half of 2017. The final specification was published in August, and since then, POWERLINK is now officially IEEE 61158.

What advantages does this standardization have for OEMs?
IEEE standards are valid for a minimum of ten years. So, for the user, standardized means future proof. It also guarantees interoperability of all POWERLINK devices, as long as manufacturers adhere to the standard. This same interoperability also applies to POWERLINK and OPC UA, by the way. The Ethernet POWERLINK Standardization Group published the companion specification in early 2017.

Are there any other advantages?
I believe we'll see manufacturers of microcontrollers for Ethernet hardware starting to implement POWERLINK more and more. Factory automation suppliers will benefit from more and cheaper Ethernet controllers with POWERLINK. Ultimately, plant and machinery operators who use POWERLINK will see their costs go down as well. ←

Condition monitoring for mobile equipment

Condition monitoring provides early warning of impending failures on mobile equipment.

Higher machine availability with mobile X90 control system
The modular X90 control and I/O system can now be equipped with condition monitoring functions. Problems can be detected in their early stages and corrected before they result in unplanned downtime. Condition-based predictive maintenance can maximize machine availability and save the considerable cost of outages and unplanned service calls.

Predictive maintenance
The X90 module allows operators to continuously monitor the status of mobile equipment. The results help determine exactly which components require maintenance and when. Typical applications include continuous monitoring of rotating machine components such as hydraulic assemblies, belts, gears and motors. The processed sensor data is also available for further use in the application.

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