

AGV

Технические характеристики

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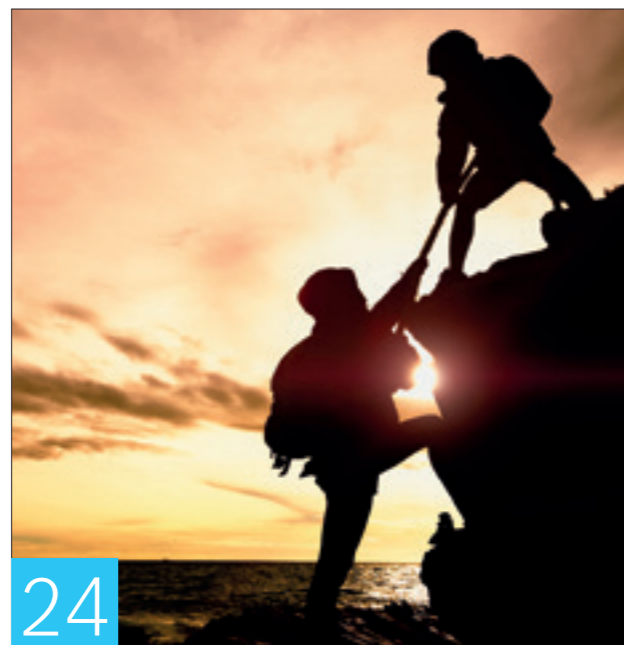
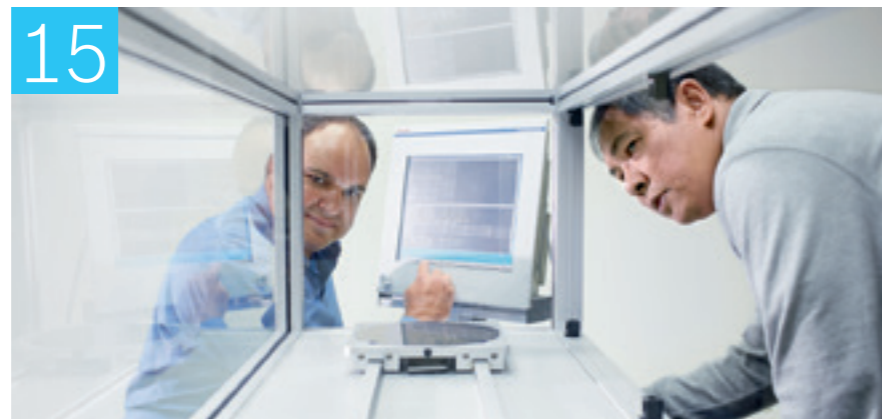
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TOMORROW'S VISION



TODAY'S

REALITY

The line between reality and the possibilities the future holds is blurring, as the Factory of the Future rapidly becomes a reality.

You need look no further than **ARENA2036** to see the progress taking place within the automotive industry. This research program explores not just design and engineering achievements specific to automobiles, but also the remarkable development of wider reaching engineering initiatives.

3D PRINTING:

Dr. Stephan Beyer, CEO of leading large-scale 3D printer manufacturer BigRep GmbH, talks to us about the latest developments in Additive Manufacturing (AM).

Q1 3D printing and Additive Manufacturing have been attracting a lot of interest. In your view, what are the main practical production benefits?

SB Today, it's already integral to the business of many manufacturers, for example in rapid prototyping, reverse engineering and the production of spare parts. But this is only a glimpse into the future of AM, which is currently revolutionizing manufacturing. It's one of the most fascinating disrupting technologies of the 21st century! By 2025, it will fully enable mass customization and assembly consolidation, make spare parts deliveries faster, and reduce spare parts inventories while also minimizing material waste.

Q2 And what are the main economic benefits?

SB Because 3D printing is re-defining supply chains, the economic benefits are evident. For manufacturers, it will reduce investments and barriers to entry markets, it will accelerate time-to-market, and it will increase part performance and value.

Q3 You recently presented a printer that will set new standards in the 3D printing industry – what makes it so special?

SB With the development partnership between Bosch Rexroth and BigRep, we're leading the way to a new dimension of AM. Our new BigRep PRO 3D printer is the world's first large-scale 3D printer, equipped with state-of-the-art CNC control systems and drives by Bosch Rexroth, firmly establishing AM as an industrial production technology. The 3D printer is now part of a

seamless digital workflow throughout the value chain. In combination with new performance materials for printing, the new machine will establish 3D printing as one of the driving forces behind the Factory of the Future.

Q4 The Factory of the Future is about more than manufacturing production technology. How do you see AM evolving as part of the bigger picture? Will there need to be greater collaboration with component manufacturers, with software developers, with standards bodies and others?

SB Yes, collaboration is essential for any breakthrough technology! Typically, key signifiers for an innovative industry are: the exchange and transfer of know-how, fast reaction times, the capacity for high-level, individualized innovation, and interdisciplinarity. All of these apply to AM, which will become a powerful driving force for more collaboration across all industries.

Cooperating with companies offering different core capabilities is essential, so we have joined the renowned DMRC (Direct Manufacturing Research Center) network at the University of Paderborn, where leading companies from around the world are working together to re-define 3D printing and AM.

This is also reflected in our BigRep teams, which bring together engineers, software developers, industry designers, electrical engineers and experts in materials.

THE FUTURE OF INDUSTRIAL MANUFACTURING

Q5 Can you give us an example of a BigRep application that demonstrates how the Factory of the Future is evolving?

SB Manufacturing spare parts is a key application. Relying on 3D printing, airlines and rail operators will be able to reproduce 10-15% of all the spare parts they need, quickly and cost-efficiently. Today, for example, an automotive manufacturer already uses our printers to re-print headrests that no longer exist for older car models.

Q6 BigRep offers the largest FFF (Fused-Filament-Fabrication) build volume 3D printers currently available in the market. Apart from obviously being able to manufacture larger products, are there other advantages to size – cost benefits, for instance?

SB Yes, there are. But more importantly, only large-format 3D printers are capable of meeting the industry's requirements for AM. A large-format printer is more flexible, because by enabling higher temperatures, the selection of filaments increases. It's more reliable in operations, it's faster, it's more precise, and thanks to a new state-of-the-art metering extruder, it's more controllable in the repeatability of printing too. As a result, it becomes more cost-efficient than smaller-format printers.

Q7 You have many major customers in automotive and general engineering. Do you see applications for BigRep 3D printing solutions in other markets?

SB Any industry requiring rapid prototyping, manufacturing spare parts or small-sized components will rely on 3D printing. This includes science and research, and medical engineering (implants), among others.



INDUSTRY 4.0: The CHINESE PERSPECTIVE

Jingsong Ouyang, a Director at the Instrumentation Technology and Economy Institute (ITEI), brings us up to speed on manufacturing technology developments and perspectives in China.

Q1 Are there any ways in which the Chinese market differs from others in regard to manufacturing and Industry 4.0?

JO Most Chinese manufacturing SMEs are still in the early stages. They need to solve manufacturing problems inside plants, such as developing and using intelligent production equipment as well as key industrial software. This will enable the visualization and information management of the production process, and achieve coordination between business processes and production processes.

Q2 What do you think is the most important development in manufacturing and Industry 4.0 in recent years?

JO Smart manufacturing has taken a rational development path in China. With project support from the Ministry of Industry and Information Technology and the Ministry of Science and Technology, as well as from local government, Chinese academia has established an intelligent manufacturing standard system and technical system.

Our technical team has developed a key system for intelligent manufacturing, which includes 11 functional modules, such as individual customization, flexible manufacturing and virtual simulation. At the same time, we've been implementing national scientific research projects and providing services to address the needs of businesses (especially SMEs) in automation and information.

In industry, outside academia, alliances of intelligent manufacturing system solution providers and industrial internet industry organizations have been established to develop and standardize platforms, provide complete intelligent solutions, and promote the transformation and upgrading of manufacturing.

Q3 What are the most exciting developments currently happening in manufacturing and Industry 4.0?

JO In recent years, central and local government in China have provided strong guidance for manufacturing. For example, central government has established an excellent ecosystem of intelligent manufacturing that comprises policies and laws, a technical system, a standards system, a market environment and skills



development. This has been achieved via measures such as financial support for various scientific research projects and demonstration projects, the development of key standards, the authorization of intelligent manufacturing pilot enterprises, and the establishment of various public service platforms. As a result, many SMEs have already seen benefits in terms of improved quality and efficiency.

Q4 What advice would you give to small manufacturing businesses that will help them grow?

JO There's no prescriptive path to intelligent manufacturing for SMEs. Improving quality and efficiency is key, and to achieve this, SMEs should first define their economic goals, such as reducing energy consumption, eliminating staff redundancy and, of course, improving quality and efficiency.

Before they embark on major change, SMEs should aim to improve their manufacturing techniques, production processes, automation equipment and levels of information management. They can draw lessons from the successful experience of other domestic and international enterprises to find a suitable implementation path.

Q5 What should large manufacturing businesses be doing to succeed?

JO Large manufacturing enterprises ought already to have good foundations of automation and digitization, so they should leverage new technology, such as internet, cloud, big data and artificial intelligence, to achieve online collaborative manufacturing across enterprises, industries and regions. They should drive towards new models, such as individual

“ We must commit to international cooperation, so as to build an international standard system.”

customization, remote operation and predictive maintenance.

In addition, these larger manufacturing organizations should adopt an ambassadorial role, establishing reproducible and scalable manufacturing models, so as to promote the overall transformation and upgrading of manufacturing in China.

Q6 If you wanted to convey one message on the potential impact of Industry 4.0, what would it be?

JO On the road to intelligent manufacturing, we should not only address automation and digitization issues, but also continuously aim to establish public service and data platforms through modern technology. We must also commit to international cooperation, so as to build an international standard system and share the outcomes of Industry 4.0.

The Instrumentation Technology and Economy Institute (ITEI) is a Chinese public service institution established in 1980. It undertakes comprehensive scientific research and tasks in the fields of measurement, control and automation related to intelligent manufacturing, discrete/process industry, batch control, robots and CNC.

FACTORIES are on the **MOVE**



Driverless vehicles on the production floor are perhaps the most visible part of automated manufacturing. We asked Thomas Fechner, Senior VP Product Area New Business, at Bosch Rexroth, about the latest developments.

Q1 The Factory of the Future will be completely flexible. Only the floor, walls and roof will be fixed. So autonomous guided vehicles (AGVs) will be essential. How far have you got with this technology?

TF The Factory of the Future will be defined by its flexibility – by how simple it is for processes, machines and people to adapt to circumstances. So when you say AGVs will be a key component of this model, you're absolutely right. They are both intelligent and mobile, and those two qualities are key elements of flexibility.

How far have we got in 20 years of AGV technology? A long way, I'd say. It can be described in terms of phases of evolution.

The first phase started in industrial environments. Plant owners lay down lines or magnetic nails, or nowadays reflective markers, which the AGVs use to locate and orientate themselves. But this is inflexible and annoying for plant operators, because it's an approach that demands infrastructure.

The second phase started silently, outside our industry, and is characterized by self-operated lawnmowers and vacuum cleaners. Essentially, they feel their way around their environment: they come up against an obstacle or a drop, and they back off.

We're now bringing this ability to the industrial environment, too! There are very exciting new possibilities for communications and control, fulfilling industry standards. We're using light detection and ranging (lidar) technology to create non-intrusive 3D maps of the factory floor.

Q2 How does it work?

TF Let's say you're bringing a new AGV onto the premises. You drive it round its entire operating space, so it can pick up lidar data and create its own map. It's the laser localization software we've created that makes the difference: the lidar sensors with which it communicates are often already in place.

Now it's armed with this information, it's ready for operation. It compares the data it receives to its own internal map, so it always knows where it is. It's as though it's guiding itself via landmarks, as people might do. Before, AGVs were feeling their way; now, it's as though they can see.

It's a simple and flexible approach for operators that makes low demands of infrastructure. Some call it 'free navigation', and describe it as the coming thing, but we've been developing it for the last five years.

“If part of the factory floor is blocked by a forklift, they can tell one another to take a different route.”

Q3 So these AGVs can 'see'. But I understand they're smart, too?

TF That's right. Typically, AGVs are pretty dumb. If an obstacle blocks their progress, they have to stop and wait. So far they're hard-coded: they have no alternative.

But our approach takes advantage of the individual perspective of each AGV. Its knowledge is shared and consolidated, so the plant map is continually updated. If part of the factory floor is blocked by a forklift, they can tell one another to take a different route.

It's like a satnav. In fact, it's better than a satnav, because it works not just for the individual AGV or 'driver' but for the whole ecosystem, finding and removing bottlenecks and optimizing the overall flow.

Q4 When will we be able to see all this in action?

TF It's at a mature stage. First integrations are taking place with pilot customers right now, and we've already showed it for the first time at IAS in Shanghai. We'll be taking it to the European market at LogiMAT in February 2019.

We'll be making the technology available in two ways. Firstly, the software will be used in our



ActiveShuttle – an AGV that delivers components in boxes on demand from a 'super market' to an assembly point on the production line. It acts like a taxi service.

And secondly, established industrial OEMs and manufacturers of forklift machinery can take advantage of the technology to build intelligence into their equipment.

What's useful for us at Bosch Rexroth is that we, too, are manufacturers. We have access to 270 Bosch plants, so we can be our own 'lead user' to prove the technology works. Several of them have been involved in this project. By using it ourselves, we've been able to gauge needs and respond to them in a way that pure academic R&D simply can't. It's enabled us to feed back some of the lessons we've learned into the market-facing versions we're launching at LogiMAT.

We're really looking forward to putting this technology on public view. People will be able to see how easy it is to integrate it into their own applications. They'll also see how affordable, safe and dependable it is. We're making these concepts real.

Q5 Where is artificial intelligence taking this technology?

TF The future is flexible, and intelligent AGVs will be a big part of it. For example, they'll be able to 'swarm': fleets of vehicles acting with one mind to deliver macro productivity benefits.

Teamwork will increase. For instance, if an AGV is needed to transport a load, the system won't simply assign the nearest available vehicle, but the one that has the best loading capacity or energy consumption for the task in hand.

Path planning will be optimized, too. Right now, AGVs are driving fixed routes, but with the developments we're launching at LogiMAT and with others yet to come, that will no longer be the case.

Another factor to consider is that it won't just be the AGVs that are in motion. Production equipment will be modular, so it can be moved around the factory floor to create new topologies specific to needs, such as unexpected increases in volume requirements, or an urgent new order for a bespoke short run. When only the fabric of the building is fixed, all assets are expected to adapt to continuous change – and they will easily rise to that challenge.

Q6 How do you see this technology being rolled out?

TF The short answer is: manageably. If you tried to implement something like this for the first time on a large scale, it could be too complicated and too costly.

The good thing about the approach we're taking is that organizations can introduce it in a controlled area to gauge its effects before any broader rollout.

Q7 Do you foresee this technology being accessible to SMEs, as well as to larger companies?

TF I'd say it's especially for SMEs. Large companies can invest in their own long-term futures. Smaller organizations can't, but when key components are made both accessible and affordable, they can take them and use them to create new, fast and flexible solutions. SMEs are known for their responsiveness and their entrepreneurial spirit. This technology is tailor-made for that.

Q8 Could industries outside manufacturing make use of laser localization technology?

TF Absolutely. I see a role for it in service applications. Waste disposal, for instance, and in other controlled environments such as cleaning systems at airports and railway stations.

Q9 Finally, do you think new business models might emerge from these developments?

TF I do indeed. If technology is simple and flexible and functional, as it is here, it's possible to envisage new pay-per-use models: companies won't need to own all the equipment they employ. The big differentiating factor is the software – and the next one will be artificial intelligence.

Engineers usually try to build the future by increasing functionality. I think, the ease of use makes the difference – especially for new, software driven technologies.



The FLEXIBLE FACTORY

Automated production lines moving with intelligence, precision, control and versatility: it's time to meet our Flexible Transport System...and ActiveShuttle, that will deliver the components to the production line.

If the Factory of the Future's benefits are to include speed and efficiency, one of the prerequisites is a sophisticated means of moving products through your machine or production line.

Our Flexible Transport System (FTS) meets that need. The FTS is unlike any conventional conveyor system. With FTS, an infrastructure can be freely defined for your machine or production line. Based on this infrastructure, individual passive carriers, without cables, can be moved and positioned independently in an easy, dynamic and accurate way.

The drive and sensor concepts are contactless, so the intelligent and open system can be adapted to different production conditions. Because the active parts can be kept outside the process environment, the FTS is well-suited to environments that need to be very clean or are very harsh.



This makes it attractive for many fields, ranging from the electronics industry to assembly and handling applications, where the FTS demonstrates its scalability in size and driving force, managing loads from a few grams up to over 1000kg per carrier.

What's more, it has a repeat accuracy of up to 1µm. So, not only is it a flexible and dynamic transport system, but also exceptionally accurate at positioning – and therefore an integral part of the assembly and production process. This often reduces complexity and the overall cost of machines and production lines.

The compact electronics of the FTS can control carriers individually, separating transport time from processing time. This avoids the unnecessary unproductive periods that occur on traditional conveyors, when products have to wait their turn as they reach slower parts of the process.

Batch Size: One

The Factory of the Future is also about the flexibility to manufacture small batches and even individual products in a sustainable and responsible way. Our FTS enables this by providing decentralized intelligence with full transparency. For example, when entering a process, an RFID chip on the carrier identifies the product and all its associated manufacturing steps. The MES system links this information with the configuration that's saved





TAKING INTELLIGENCE TO THE EDGE

with the order, enabling the FTS to align each single product according to its individual specification. Set-up times are thereby reduced to zero, even for one-off production runs.

Open standards, such as OPC-UA, ensure smooth machine-to-machine communication and enable the FTS to be integrated into any higher-level industrial control system that schedules, controls or monitors your machines or production lines.

ActiveShuttle

There is, of course, another prerequisite to speed and efficiency – and that's the prompt supply of products to, and collection from, the machine or production line. This is where our ActiveShuttle enters the picture.

ActiveShuttle is an autonomous guided vehicle (AGV) that delivers components in boxes on demand to assembly points on the production line. In our first product version, ActiveShuttle transports lean dollies. It's a flexible solution in which a wide variety of transport concepts can be implemented – cyclical transports as well as demand-oriented material supply. (You can read more about exciting AGV developments in the interview with Mr Fechner, starting on page 12.)

Developments such as our FTS and ActiveShuttle will play a leading role in reducing transport time, optimizing cycle time and increasing manufacturing output. That's why they represent a significant step forward on the road to the Factory of the Future.

Factories will be truly smart when they know what's happening at the point of manufacture, and can act on it. Here's how to get there.

In factory automation, the outermost points of IT networks are machines, sensors and devices on the shop floor. If their data is not processed centrally, e.g. via a cloud, but decentralized directly at the edge of the network, we're talking about edge computing. So an industrial IoT Edge solution could be, for example, an industrial PC running analytics for a machine, or a server on-site that provides KPIs for a production line.

The benefits

Bringing intelligence to this 'edge' means increasing knowledge and control derived from such points. Our IoT Gateway software makes data already easily available on the edge. Therefore it is a natural starting point for intelligent edge solutions. We want to deliver easy-to-use, highly customer-focused solutions, ranging from historical visualization of machine KPIs to condition monitoring for drives. End-users and OEMs can choose suitable applications. This gives not only a transparent value proposition but also a reasonable price per application.

Edge computing is a highly available approach that enables end-users to connect and analyze legacy machines that are completely offline, saving on network bandwidth at the same time.

It's scalable, too. End-users often like to start with low-cost, easy-to-use, small and local solutions to test the value of their applications. When the results are known, they can then move to a full roll-out, without much need for adaptation. What's more, no additional effort is needed to access cloud applications with more computational power and storage at any time.

Information is precise, as a result of high sampling rates via short local network connections, and security is tight because outside communications are limited. Data is aggregated, reducing network loads.

Getting started

Any application that's provided as part of an intelligent edge solution and that doesn't necessarily need the computational power or the massive amount of storage provided by the cloud, can be installed via software or a pre-installed device. This allows even smaller companies with less IT expertise and infrastructure to create value from the data gained – even where there's only a single machine on the edge that needs monitoring.

A complementary front-end application in a cloud is required if the scope of a solution exceeds the capability of the application on the intelligent edge. This is the case, for example, if an entire plant or

multiple plants is condition-monitored, if artificial intelligence is used to predict failures, if detailed quality data of the entire outcome of a plant needs to be stored long-term, or if all the maintenance and service activities are being managed in a plant. Our IoT Gateway software can be easily connected to a variety of preconfigured cloud systems, including Microsoft Azure, Oracle IoT Cloud or Amazon Web Services.

As time passes, the number and range of customer-focused solutions we're able to offer is set to grow. They'll start from a common base, and on this we will build different applications in line with customer need – for instance, availability monitoring or predicting machine breakdowns.



Article by Hans Niessen

Business Development Manager for Semicon, Electronic Manufacturing and Flat Panel Display



Article by Julian Weinkoetz

Product Manager for Data Analytics in the area of PLC and IoT Systems

The FUTURE of HYDRAULICS has STARTED

New ways of thinking and new design approaches for hydraulic power have arrived. With the CytroBox, we are revolutionizing hydraulic systems and are sustainably changing people's perception of hydraulics. We are writing a new chapter in the history of hydraulic drive and control technology.

Less consumption, more efficiency

CytroBox hydraulic power units have a power range from 7.5 kW to 30 kW, and offer an intelligent combination of speed variability, synchronous motors and axial piston pumps. Efficiency is achieved via the optimum adjustment of servo motor and pump, and also by demand-oriented energy consumption. Predefined controllers in the variable-speed pump drives adapt the energy requirement of the machine to prevailing conditions. So, at partial or zero loads the speed is lowered, saving energy, while at full load it's increased. This flexibility delivers energy savings of up to 80 percent compared to units driven at constant speeds.

The hydraulic block has been manufactured using an additive manufacturing method, resulting in a design that is up to 40 percent more compact and with improved flow channels. This, in turn, reduces pressure loss and minimizes leakage because there are fewer plugs.

Less noise emissions, more flexibility

CytroBox hydraulic power units also keep noise to a minimum. Airborne sound is swallowed by the compact arrangement of all components in the unit housing and by built-in sound insulation mats, so no sound escapes. The motor pump group is rigidly fixed to a polymer-concrete foundation. The damping bearings, which typically transmit the noise to the tank, are completely eliminated. The compound polymer-concrete foundation increases the inertial mass, whereby the center of gravity of the power unit is located deeper. Any vibrations which arise are absorbed efficiently. Consequently, the noise emission of the hydraulic

power unit is less than 75 dB (A) – even at full load. Comparable power units have an average noise level of 85 dB (A).

A low level of noise pollution reduces the need for additional measures and ensuing costs for noise reduction, and also makes working very pleasant, even in direct proximity to the hydraulic power unit.

Smaller footprint, more power

CytroBox's all-in-one power unit saves space on production lines. It combines a small footprint with a compact design, which also includes the degassing and flow-optimized tank. Thanks to a CFD simulation, the oil volume is reduced by 75 percent from 600 liters to 150 liters. What's more, its high-performance synchronous motors have a length of only 400mm and a diameter of 200mm, making them up to 80 percent smaller than comparable asynchronous motors. Further advantages of the synchronous technology include higher dynamics and increased energy density.

In addition to the compact components, all cooling lines are eliminated thanks to the innovative water-cooling concept.

Fewer surprises, more availability

Modern Automation Concepts will only be future-proof if they are also capable of adapting to upcoming innovation and new environments. Machines and their modules will exchange information and commands utilizing open interfaces, wireless technologies and smart Condition Monitoring concepts. The CytroBox comes with just this kind of thinking in mind.

The CytroBox is equipped with a preconfigured and wired Sensor Package, which is processed by the drive. Multi Ethernet interface and Open Core Interface

enable the convenient usage of this data in higher-level data systems or modern Machine Automation Architectures.

Furthermore, the included CytroConnect IoT service unlocks the potential of IoT technologies to operators as a Pay-per-Use Service – Plug&Play and riskless. All information on the power unit is easily at hand anywhere you go – whether component states and operation point, upcoming maintenance needs or predictive analytics utilizing the Rexroth Online Diagnostics Network (ODiN).

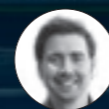
Powering Hydraulics in the Factory of the Future

Manufacturers have always needed energy efficiency from their power units, and compactness and low noise levels are sure to have been on their wish-lists too. In recent years, these demands have been joined by others, and in particular by the new levels of efficiency and flexibility that digital transformation can bring.

All such requirements are met in the CytroBox, a valuable asset in the Factory of the Future.

“The CytroBox combines our latest technologies in a compact and attractive design. It is revolutionizing the market and setting completely new standards. The result: the footprint is reduced by 50% and at the same time there is a noise reduction of up to 70%. In addition, the CytroBox saves up to 80% of energy, up to 75% of hydraulic fluid and provides ready-to-use connectivity.”

Jörg de la Motte, Senior Vice President of Industrial Hydraulics, Product Area – Power Units & Manifolds



Article by Andreas Günder

Senior Manager, Development Basics and Innovations – Hydraulic Power Units and Manifolds



Watch our Big Bang movie on our YouTube channel

WHEN EFFICIENCY is on the LINE

Wöhner GmbH & Co. KG is able to assemble around 40,000 fuse holders with up to 94 variants per day, thanks to their new assembly line.



These impressive production figures have been achieved with the aid of a new, fully-automated line incorporating our ActiveMover transfer system – a system that transfers 20 workpiece pallets in asynchronous operation, with short transportation times between the processing stations.

The technology behind an efficient future

In just six months, Wöhner was able to configure and commission a fully-automated fuse holder assembly line based on our ActiveMover. This is a linear motor-driven transfer system with vertically arranged workpiece pallets. The movement profiles for the pallets can be defined completely independently of each other, and the modular structure of the system makes it easier to make future modifications.

The goal was to have automatic retooling for part feeding and the capability to integrate this into fully-automated processes. To achieve this, all the wiring runs through cable channels on the inner side of the transfer system, which means there's unrestricted access to the outer sides and the workpiece pallets. ActiveMover has a completely modular structure and, in line with its needs, Wöhner has combined 10 straight and two curved sections to create an oval system of 12 meters in circumference.

Dynamic, yet gentle

Wöhner has installed two nests for fuse holders on each of the workpiece pallets. The cycle time at each station is less than three seconds per component, and the workpiece pallets are conveyed to the target position independently of each other with an accuracy of 0.01mm. In some sections, the pallets have to brake and accelerate gently, so that the components don't shift around, whereas on other sections they can run at full speed.

The individual fuse holder components are then placed on the workpiece pallets by robots and pick and place stations. Cameras monitor and record the work steps. When the components have been mounted in the correct position, the controller releases the transport to the next station. Thanks to the linear motor principle, the workpiece pallets can also change direction, if necessary.

Finally, the fuse holders are welded using ultrasound, before being printed at a subsequent station. At the final station, the finished fuse holders are removed from the workpiece pallets and placed on our VarioFlow plus conveyor system for transfer to the automatic packing system.

“We rely on highly productive assembly technology to keep our unit costs down.”

Andreas Friedrich,
Head of Robotics and Software Development
in the Production Equipment Unit at Wöhner

Flexibility for multi-variant assembly

Fuse holders are assembled in up to 94 variants, with and without LED fuse monitoring, with four different housing designs and various customer-specific printing. The company also manufactures versions with and without an additional insert. When integrating each of the stations, the production equipment engineers parameterized and adjusted the appropriate movement profiles and positions of the workpiece pallets.

Thanks to AMpro (ActiveMover program), no programming effort is involved in adding target positions and movement parameters. An even easier method of defining the target positions for the transfer system is moving the pallets manually. ActiveMover also comes with integrated collision avoidance functionality to prevent damage to the workpiece pallets. The modular structure of the system makes it simple to modify the hardware and software to accommodate new tasks.

Robust workpiece pallets

The system's workpiece pallets are designed for payloads of up to 10kg. At Wöhner's manufacturing facility, the payload is 6.3kg. To cope with the process forces generated during welding, the workpiece pallets are supported by a cylinder. This avoids any delays caused by having to remove the nests from the workpiece pallet, place them on a supporting base, and then return them to the pallet after welding.

The system is particularly robust, enabling three shifts to run every day for many years to come. With ActiveMover, the worn part costs are reduced.



Article by
Maria Menezes Strauss
Product Manager, ActiveMover
Transfer System

INTRODUCING THE TRANSPARENT WAREHOUSE

ActiveCockpit is our interactive communication platform that enables the processing and visualizing of production data from existing system landscapes and various data sources in real time.

This means that the entire production process can become more transparent – with current quality and production figures available for immediate analysis.

Until recently, ActiveCockpit has mainly been used in production. However, the possible applications are diverse, and Bosch Thermotechnology is now using it for the first time in the field of warehouse logistics at its Local Distribution Center (LDC) in Wetzlar.

Its LDC operates as an outsourcing model together with LGI Logistics Group International GmbH. The warehouse stocks devices and accessories from the Buderus brand, from boilers to fittings. The customers are heating engineers, who can place orders up until 8pm and expect to receive their goods the next day.

As demand in the heating industry is subject to seasonal fluctuations, the volume of delivery items to be shipped each day varies significantly, from 3,000 to 6,000 pieces.

“The main benefit is that the warehouse saves a lot of time and can be controlled faster and better.”

An effective and versatile solution

Just like production workers, logistics personnel can benefit greatly from access to key data regarding output, capacity utilization and resource distribution. Before ActiveCockpit was available, this information had to be extracted individually from SAP EWM (Extended Warehouse Management) – a laborious and time-consuming process.

ActiveCockpit processes the data provided by SAP EWM and displays up to four key figures in a clear four-color chart. This data is updated every 15 minutes, so employees in warehouse control, the dispatchers and warehouse managers, can always clearly see the status of each order. The software also gives an overview of the current resource usage and the expected workload in relation to the currently used resources.

Every day at 5pm, a traffic light signal for each activity area indicates whether the worklist can still be processed by the cut-off time of 8:15pm. This means that bottlenecks or overcapacities can be identified – which dramatically improves delivery reliability.

“The main benefit is that the warehouse saves a lot of time and can be controlled faster and better,” explains Bosch Thermotechnology’s Project Manager, Michael Schatz.

Bosch Thermotechnology also has warehouses in Berlin, Bondorf near Stuttgart, Hamburg, Herten and Ingolstadt, and will roll out ActiveCockpit in these

locations. “It’s also planned for mapping the goods receipt process in addition to the goods issue process and perhaps other areas such as packaging,” Michael Schatz says.



A logistics employee establishes the data connection to SAP.



Article by Denis Barrier

Leader of Product Management for Manual Production Systems & Basic Mechanic Elements

Measure, correct and optimize

ActiveCockpit enables users to compare current actual states with target states and initiate corrective measures or optimize processes if necessary. The software is a scalable, versatile communication platform that has already proven itself in manufacturing. It can be used to network different IT and production systems in preparation for Industry 4.0. Data from ERP, MES, various subsystems or office programs, which would otherwise have to be compiled manually, is automatically compiled by ActiveCockpit in real time.

Thanks to open interfaces, the data sources have virtually no limits and the system is fully interactive. Whiteboard, escalation, email, explorer and mobile functions help decisions to be made more efficiently. There are also various graphic options for the visualization and evaluation of data.

ActiveCockpit consists of a basic package and user-specific add-on applications. For example, the use of the software in the area of logistics includes the diagram module, which allows real time connection to back-end systems (ie. SAP and other ERP systems such as Infor, Sage, Oracle and so on) and the visualization of key figures.

In 2014, Bosch Rexroth received the Industry 4.0 Award for the best combination of man, machine and process for an assembly line in which ActiveCockpit functions as a central component. The German Design Council honored the solution with the German Design Award “Special Mention” in the Human-Machine-Interface category in 2017.

PERFORMANCE THROUGH PARTNERSHIP

Our collaboration with Samac proves the power and importance of shared intelligence for Industry 4.0 innovation.

Founded in Italy in 1975, Samac is a specialist producer of assembly and testing machinery, mainly for the automotive industry. Put simply, Samac builds machines that build components – leading the field in oil, vacuum and water pump systems, and the assembly and testing of brushless electric motors.

The Brescia-based company, which doubled its production area at the end of 2017, presented us with a forward-thinking proposal. We'd not only supply the firm with components for its new assembly lines. We'd also help train Samac staff to identify new engineering opportunities that the business could, in turn, provide to other customers.

These customers included the Bosch Group, taking the story full circle to deliver a showcase in collaborative innovation.

Better together

Partnership was the strategic choice for Samac, who aimed to double its production capacity while maintaining the exceptional levels of quality demanded in the manufacture of automotive powertrain and safety components.

Plant reliability was key, which is why the team chose to use our pallet lines, electric cylinders, electric screwdrivers, drives, motors and operator panels for its new lines. Our systems offer industry-leading efficiency, while the modularity allows for factory expansion and development into the future.

Samac began to integrate our components into its assembly and testing lines almost 30 years ago. Throughout that time, we acted as a consultant for Samac's technical and design choices, before training some of its 75 employees and associates to operate the systems.

The best test

This learning was then put into practice in our own factories. Since 2007, Samac has been supplying new assembly and testing systems to Bosch Rexroth Oil Control for its hydraulic components, and to another Bosch plant for its vacuum pumps since 2015. The last one was engineered, manufactured and delivered in 2017.



This Bosch plant – supplied by Samac – therefore offers a good example of Industry 4.0 in action. Designed for the assembly and testing of car vacuum and oil pumps, the line uses our modular system in a lean manufacturing layout.

Components are equipped with poka-yoke checks for all manual operations, while our data monitoring and registration systems provide total traceability and interconnection between plants.

Bosch Rexroth components used at the Bosch plant include:

- Our **IndraControl XM21** control platform to manage the complete automation of the production line. INTEL ATOM processors supply calculating power and open communication standards allow components to 'speak' to each other.
- Maximum system control is provided via a combination of **single-channel (CS3515-D)** and **multi-channel (SB356) racks**. These systems ensure maintenance-free reliability for up to one million cycles, delivering notable running-cost savings.
- System access via our **IndraControl VR2109** operator panel. Stations are controlled via a nine-inch touchscreen display, including production parametrization and powerful diagnostic tools.
- Axial movement via an **EMC axis**, coupled with our **IndraDrive CS drive**. Compact and versatile when used together, these components are combined with powerful brushless motors from our **IndraDyn S** range
- Finally, our axial screwdrivers with torque and rotation angle control, ensure plant safety and consistent screw-tightening across EC303/3GE27/3DMC017/G2A152-type screws.

Tomorrow's technology, today

The Bosch plant's blend of Samac's expertise and our systems means that the new Bosch line offers breakthrough efficiency and reliability.

For Samac, such projects are a showcase of the business' leadership in the development of applications for electric pumps and the know-how gained in automotive electrified components. For us, they demonstrate the range of applications and rich potential for our product family, our automation competency and our well-honed partnership skills.

For the manufacturing world, the collaboration proves the power of partnership for unlocking new possibilities within Industry 4.0.



Article by Massimo Gattillo
North West Channel Management

JOURNEY to a LINEAR FUTURE

The speed at which information technology is changing factories is remarkable. But how are the more basic technologies progressing on their journey to adapt to the Factory of the Future?

Until recently, Linear Motion Technology has been considered to play a mainly mechanical role, but recent developments in digitalization have changed all that.

The Digitalization of Linear Motion Technology

The Linear Motion Technology 'journey' includes configuration, ordering, commissioning, operation

and maintenance. We're here to guide and support you throughout the entire process chain – with software tools, online services and intelligent systems that meet your factory's needs – maximizing production and shortening time-to-market. As well as providing solutions for manufacturers today, we're constantly refining and developing our technology to fulfil the needs of the Factory of the Future.

5 steps to a shorter time-to-market



Step 1 product selection and sizing

Time is money in manufacturing. That's why we've significantly simplified this first step. Our seamless online tools enable you to configure linear components and axes, and in future even entire multi-axis systems, with increased speed and simplicity. After entering constraints such as stroke, workpiece weight and cycle time, the tools generate suggestions that the user can verify in their CAD environment. In future, a digital twin will accompany the components and systems for the whole lifecycle. This will be integrated into a virtual environment that will allow users to load simulations, for example, directly into the control system.

Step 3 commissioning

In the future, all system data will be available – including all access data – which will save a lot of time. The axis parameters can be stored digitally in different ways, whether in the motor encoder, in the integrated measuring system or in the digital nameplate.

Step 4 operation

Linear Motion Technology will need to play a key role in the operation of the Factory of the Future. Data, such as temperature and vibration, will be picked up by sensors, which could be integrated, for example, into the runner blocks of linear guides or attached externally to the axes and connected via open interfaces. Our intelligent servomotors are another option capable of handling sensor functions. This data can then be passed on to our cloud service ODin to undergo further analysis. Information such as machine availability, quality and efficiency will be displayed, so you're always well informed, wherever you are, and able to react quickly.

Step 5 service and maintenance

In the future, the sensors in our Linear Motion Technology will be able to record operating conditions permanently and tell you what maintenance, servicing and spare parts are required. Thanks to the digital nameplate, the parts list and configuration of the linear modules is known. So the relevant spare parts are displayed directly in the online shop and can be ordered with the click of a mouse. For added peace of mind, we'll also provide a range of manuals and how-to videos online.

Step 2 ordering and delivery

Because all the product data will be available, products can be ordered in a few clicks. We can receive orders, commission systems and despatch almost immediately. In future, order tracking will be available throughout the process.

An ongoing commitment to the journey ahead

Linear Motion Technology enables us to help you tap into previously unused potential to increase productivity and flexibility during your day-to-day operations. It reflects our commitment to make sure that Linear Motion Technology continues to be a key component of the manufacturing process today, whilst also developing the technology needed in many years to come.

In the future, our Linear Motion Technology solutions will enable

manufacturers to capture data, optimize processes and predict wear sooner and more accurately than ever. We already have clear ideas of how to intelligently integrate our Linear Motion Technology into the Factory of the Future, in which production will be changed over via software command, and sensors will monitor all operating conditions – which in turn will enable predictive maintenance to significantly reduce downtime. The journey towards these goals has already begun.

MOVING FORWARD

Our electronic transmission control systems are creating new options for a French handling equipment manufacturer – and for its customers too.



Article by Didier Krupezack

Sales Engineer, Mobile Applications,
Bosch Rexroth France

Manitou, a leading manufacturer of handling and lifting solutions, decided to use our electronic transmission control systems on a new agricultural telehandler manufactured at home in France.

Maxime Vinconneau and François Brochard from the R&D department explain the reasons for this choice and give us feedback on the use of the BODAS-drive DRC application software.



Maxime Vinconneau (left) and François Brochard (right).

Q1 How does the new machine you've developed with Bosch Rexroth fit into your range?

This new machine is a compact model in our MLT range of agricultural telehandlers that offers two types of transmission – hydrodynamic and hydrostatic with electronic control – as we want to provide solutions to meet all needs, such as farm configurations, and transmission variations specific to usage in various countries.

This new model is also part of our Reduce program, which aims to help farmers reduce their CO₂ emissions and their total cost of ownership.

Q2 What does the electronically controlled hydrostatic transmission bring to this type of machine?

Hydrostatic transmission offers more flexibility in terms of design. Taking out the mechanical gearbox makes it possible to create more compact machines. It's also more precise, flexible and comfortable to use, especially as there are no gears to change.

What's more, the electronic control provides standard functions that are increasingly appreciated by users, such as inching, speed limiter, eco-mode and manual accelerator. It also offers the possibility of combining

flexibility and precision with dynamic behavior, something that is more difficult with other technologies.

Compared to conventional hydrostatic solutions, electronic control helps to reduce fuel consumption, better protect components and facilitate diagnosis in case of failure. All these benefits are in line with the Reduce program we just mentioned.

Q3 What are the advantages of the BODAS-drive DRC application software?

The DRC platform contains many features that we can control and use to make our own settings, which gives us plenty of options for customization. This is essential for us, because it means we can create the profiling that will allow our users to recognize, in the behavior of the machine, Manitou's specific characteristics. For some functions, users can also create their own settings.

DRC contains all the Bosch Rexroth expertise in hydraulic control, which means we don't have to start from scratch. The expertise of the platform combined with the skills of the teams make it feasible to deploy a transmission very quickly: it's possible to reach 80% of the expected results in just one week. The remaining 20% requires more time, because it is a matter of further optimizing the results on the basis of the evaluations of our testers and users. But again, DRC provides an advantage: as we have control over the settings, the change loops are much quicker.

Finally, after the appropriation phase of the first project, the DRC software platform really saves time in development. This is a real point in its favor for subsequent projects.

Q4 How did the cooperation with the Bosch Rexroth teams go?

We're long-standing partners, and we've always had a good relationship. Bosch Rexroth really makes an effort to understand our needs. On this project, we particularly appreciated the availability and reactivity of the teams, but also Bosch Rexroth's ability to customize its software to meet our needs. The result is not an off-the-shelf product, it evolves according to our own constraints, and we feel our demands are heard.

Q5 What other projects are you working on with Bosch Rexroth?

We're in the process of demonstrating new solutions on a new machine. We're also interested in the possibilities offered by the BODAS-drive eDA software. It seems it might be faster to apply than DRC, and might allow us to further reduce our development time – so it could be well-suited to some of our product ranges. We aim to test it this year on a machine well-known to our users to evaluate the new features provided.

DRIVING THE DRIVERLESS FUTURE

Safety and performance are paramount to the future development of autonomous vehicles. This will require both thousands of kilometers of road tests and potentially billions of miles of simulator tests.

Much of this can be achieved virtually through computers, but it will also require a real simulator, similar to those that have long existed in the aviation sector.

To achieve this, Groupe Renault are currently preparing for the launch of their new 25M€ simulation facility at the Renault Technocenter near Paris. Designed specifically for the testing of autonomous vehicles, it will host one of the most advanced dynamic driving simulators in the world.

As global leaders in the field of drive and control solutions, we were the natural choice to supply the motion platform for the new automotive simulator that's being constructed by system integrator company A. V. Simulation.

"For a safe autonomous vehicle product for all, we need to validate on billions of kilometers. To complete physical tests, the only way is the massive simulation, with a large number

of driving scenarios. One of the worst-case scenarios is the handover between manual and autonomous mode in different traffic situations. The new high-performance dynamic driving simulator will help Renault to test all these cases in the most efficient and realistic way with real drivers in the loop and design the best experience for the final client." Olivier Colmard, Integrated CAE & PLM VP Renault Engineering.

The technology to deliver

When the project is completed, it will be the most advanced automotive motion simulator ever developed. A system that will be capable of delivering accelerations up to 1 g as well as speeds up to 9 m/s in both longitudinal and lateral directions.

Our state-of-the-art motion platform consists of a high-performance hexapod and rotating yaw table, all on top of an x-y table. This incorporates new technologies and linear motors to create a machine that accepts a 6000kg payload, yet delivers high acceleration and velocities.

"Renault provided very detailed specifications on the simulator they required and the Rexroth system fully matched it," said Olivier Anselme, Sales Director at A. V. Simulation. "Their long experience in this field was also a crucial factor. We have been working with Bosch Rexroth for many years and have a strong relationship."

Precision, safety and efficiency

On completion, the motion platform will be installed by Bosch Rexroth and fitted with a dome by A. V. Simulation that will immerse the driver in a realistic virtual reality traffic scene. The dome will house a test vehicle equipped with head and eye tracking systems and be able to accommodate drivers and passengers, which makes safety absolutely paramount.

To achieve this, the motion platform features lots of safety measures. Both mechanical and software motion limiting features have been incorporated, so the system cannot exceed its programmed limits. Drives are equipped with our 'Safety on Board' technology that provides additional security measures such as guaranteed safe stop.

Most of our previous XY motion systems have relied entirely on a rack and pinion design, but because of the high speeds and accelerations, we've used our linear motors in the new platform. These are very quiet with very low vibration levels, ensuring the control system can control the platform with extreme precision, even while moving the heavy payload at high speed.

High performance at high speeds does place a heavy demand on power. However, our innovative design helps minimize grid power requirements by incorporating the Rexroth 4EE (for Energy Efficiency) technology that can store and reuse the energy generated during deceleration phases.

“For a safe autonomous vehicle product for all, we need to validate on billions of kilometers.”

Installation of the new platform will begin in Q3, 2019, and is due to be completed by the end of 2019. When the simulator is launched, it will allow Groupe Renault and the Renault-Nissan Alliance to continue delivering advanced technologies by furthering autonomous vehicle development testing in a virtual environment.



Article by Hans ten Hagen
Sr. Manager, Sales Motion Simulation



CUTTING EDGE SOLUTIONS

Smart hydraulics are taking performance levels in the timber processing and handling industry to new levels never seen before.

Woodgrain Millwork, a family-owned millwork company based in Fruitland, Idaho, has been in business for more than 60 years. They're one of North America's largest producers of mouldings, millwork, windows and doors.

In 2016, the company acquired a sawmill in Emmett, not far from its Fruitland headquarters. In a bid to modernize the operation and increase the versatility of its offering, Woodgrain made a strategic decision to purchase a HewSaw SL250 2.2 multiple breakdown sawline. This enabled the sawmill to incorporate two breakdown lines – one for larger logs, and the HewSaw for logs under fifteen inches in diameter.

The HewSaw line has the capacity to run up to 20 logs per minute on a scan-then-set basis. That is, each log is scanned, and a sawing solution developed. No two consecutive logs require the same solution. The sawline has to adjust tooling for every log, and this in turn requires up to 75 linear axes – all hydraulically motioned – to be shifted for each log. The time allowed for movement is typically less than 500 ms, and the precision required is measured in less than 0.001 inches.

The engineering that makes this happen is, of course, crucial to the process. The hydraulic system, from power development through to motion control, must drive these axes to carry the tooling into position with great speed and with great accuracy. This process also needs to be reliable and repeatable throughout the life of the equipment.

The intelligent solution

HewSaw US Inc., a division of Veisto Oy of Finland, that supplied the sawline, is a leading supplier of state-of-the-art primary breakdown lines found in all major sawmill markets around the world.

To meet its demanding engineering requirements, the manufacturer selected Bosch Rexroth Canada to provide the main hydraulic power unit (HPU), which is equipped with the latest generation of Sytronix hydraulic drives and control units. Because of the rugged hydraulics and efficient electronics found in our Sytronix system, it's regarded as the intelligent solution for many of the sawmill industry's hydraulic power requirements today. This system, with its energy saving capabilities, is being sought out more frequently in an era of higher energy costs.

In response to this tall order, we configured the most advanced hydraulic power unit to date. System simulation was achieved through Rexroth's Simster, a powerful multi-domain simulation platform for modeling and optimizing controlled drive systems. PLC supply and programming development was used for seamless integration with the upper level PLC system. The Sytronix application was also integrated into the Industry 4.0 environment for real-time efficiency and multi-protocol capability.

“It's the most advanced smart system we've produced.”

In my view, the Sytronix implementation for HewSaw is the most ground-breaking system Bosch Rexroth Canada has developed for the industry, with self-diagnostics in the hydraulic power unit (HPU) that communicates any faults automatically to operators. The HPU is smart, not just in this respect, nor just in the accurate positioning of tools, but in how it supports log flow into the line. There's higher potential velocity and capacity for improved gap control.

High performance, low energy, low noise

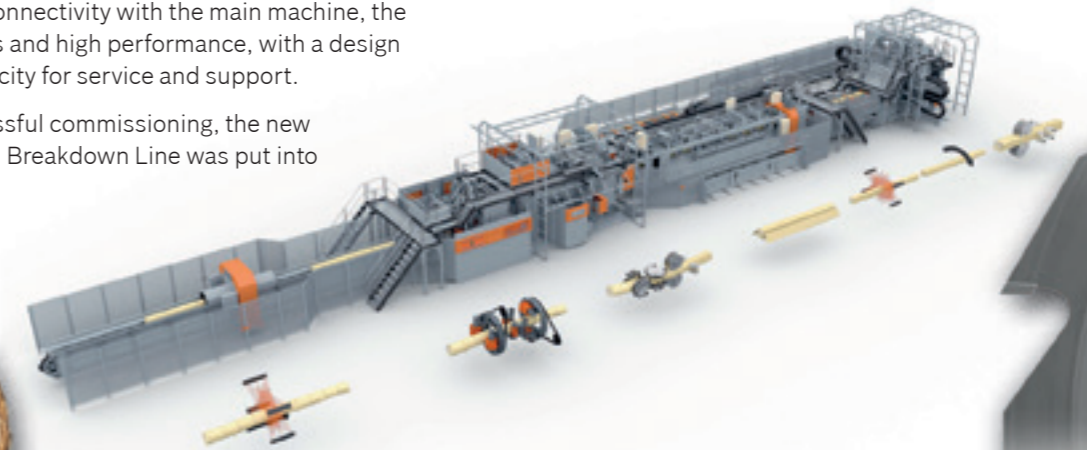
That's not all. System benefits include energy savings that decrease operating costs and reduce CO₂, resulting in a lower carbon footprint. Sytronix drives can also reduce the noise emission of the hydraulic power unit. Shorter installation and commissioning times are achieved by using pre-configured Sytronix hydraulic pump drives and assemblies. The advantage for the customer is the connectivity with the main machine, the enhanced safety features and high performance, with a design that lends itself to simplicity for service and support.

After efficient and successful commissioning, the new HewSaw SL250 2.2 Multi Breakdown Line was put into

production in February 2018. We believe its success could not have been achieved without the great teamwork between Bosch Rexroth Canada's Systems Engineering group, Sytronix System Specialist and the Port Coquitlam, BC service team.

The good news doesn't stop there. The performance and versatility of the systems developed for HewSaw US Inc. are suitable not only for application at the Woodgrain plant in Emmett, but also for a variety of other markets, including wood processing, pulp and paper, presses, plastics, die casting and machine tools.

It's the most advanced smart system we've produced. It was a joy to build, and it's the crown jewel for Bosch Rexroth Canada's Sytronix Application and Engineering team – an advanced HPU system that all our employees can learn about and take great pride in.



Article by Rodney Trail
IPM Group, Business Development

STOPPING SAFELY

Rail car buffers are crucial to safety, and our smart hydraulics systems are playing a vital role, while also reducing hardware and software complexity for Lindenberg Technics.

Rail car buffers, located on the front of freight cars, consist of massive steel sleeves with a powerful spring assembly. They absorb the shocks which could otherwise cause a train to swing out and derail. Because of their crucial role in safety, they need to be checked regularly.

A full inspection is not possible while the buffers are still installed, so they need to be removed and tested on special test rigs. To do this, the specialist machine manufacturer Lindenberg Technics in Switzerland recently developed a customized hydraulic press that integrates data and control technology into Industry 4.0 environments.

The key testing element, together with the closed-loop control, is provided by our servo-hydraulic actuator (SHA). SHAs are complete drive units in which digitally controlled hydraulic movements are generated by variable-speed pump drives from our Sytronix product line. Lindenberg sought an extremely wide range of test forces and speeds, ready to go and with minimal hardware and software engineering effort – and only we could tick all these boxes.

Smart controls...

In fact, we put together a complete package consisting of a power unit, hydraulic components, the MLC motion control system for multi-axis applications, servo controllers and servo motors, as well as pre-programmed software. In a closed-loop control circuit, the speeds for the Sytronix pump drives of the power unit adjust to the current power demand of the actuators and work up to 80 percent more energy efficiently than constant pressure systems.

For motion control, we had already created libraries of hydraulic-specific functions and features. This meant that programming was unnecessary during



commissioning, and that all the technicians had to do was set the parameters.

...and smart analysis

The press gathers all relevant data for each test and stores it on higher-level systems. Motion control supports all common, hardware-based real-time Ethernet protocols for a seamless exchange of information, and integrates with an OPC UA server in networked IT environments. For example, if force progression doesn't correspond to the target values, the deviations indicate where the problem lies, and what rectification is necessary to restore the proper function.

Lindenberg Technics brings its engineering knowledge and passion to both custom solutions and standard machinery. In addition to testing rail car buffers, the solution can be used to test train equipment, as well as for customer-specific assembly processes.



Article by Christian Bucher

Sales Engineer



and Josef Müller

Sales Engineer



SWEDEN



BRAZIL



CANADA

Time for others

Wherever our colleagues are situated around the globe, they're always willing to give their time and energy to make a positive difference.

SWEDEN

The team make a contribution to global charity SOS Children's Villages, each time a customer completes their survey.

BRAZIL

Our colleagues take part in voluntary work for the Robert Bosch Institute, which promotes social evolution, with a focus on educating young people in developing countries.

CANADA

The team have been constructing fences and decks to help Habitat for Humanity Niagara, an organization that provides affordable homes for families in need.



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