

# The Transparency Initiative

## Bosch Rexroth's Factory of the Future Aims to Improve Production Processes One Application at a Time

Matthew Jaster, Senior Editor

**It's February 2020 and 'Show and Tell' appears to be just as important today as it was back in the 1980s.**

The Bosch Rexroth Factory of the Future exhibit in Hoffman Estates, Illinois — roughly 33 miles outside of Chicago — lets clients, guests and trade journalists see how the company is applying IIoT/Industry 4.0 technologies via real-time manufacturing applications. At first glance, the small exhibit hall is like a hands-on science lab where a variety of stations highlight what Bosch Rexroth is working on in areas like connectivity and distributed intelligence.

It's honestly a nice change of pace to go step-by-step and talk with Dave Cameron, director of sales at Bosch Rexroth - Automation and Electrification Solutions, and Arnie Mueller, director of operations and service at Bosch Rexroth Electric Drives and Controls, about how these IoT solutions are being implemented across the organization.

The *PTE* editors have read countless press releases on smart manufacturing and IoT in recent years, but the value of seeing exactly how these solutions benefit the factory floor certainly helps to imagine the tools a motor, bearing, or gear drive manufacturer will have at their disposal in the future.

### A History of IoT Innovation

Worldwide, Bosch Rexroth has more than 100 Internet of Things (IoT) projects running in a variety of industries and applications. The Bosch Rexroth drive and control technology engineers work on many of the Industry 4.0 technologies used in Bosch manufacturing facilities (including its own Rexroth factories).

This gives Bosch Rexroth the ability to test solutions within its "four walls" in real-world applications before making the products available to the

market, ensuring that only the highest-quality technological advancements are sold. In 50 plants across the globe, Rexroth manufactures products that put technology in motion, from hydraulic motors and pumps, to electric drives and controls, to linear motion and assembly technologies.

"At Bosch Rexroth, our differentiators are that we have open, smart devices (where controls, drives and motors become smart sensors) that offer the highest degrees of connectivity; for example, we use Multi-Ethernet and IO-Link in all our drive and control technologies," Cameron said.

In the Factory of the Future everything is connected, from field level to cloud-based IT systems. Rexroth automation solutions use open standards to enable the highest level of connectivity. Rexroth uses Multi-Ethernet and IO-Link in all drive and control technologies. All components, modules and machines will be able to exchange information with IT in real-time without having a central execution system (e.g., distributed intelligence). The result: Total transparency in the Factory

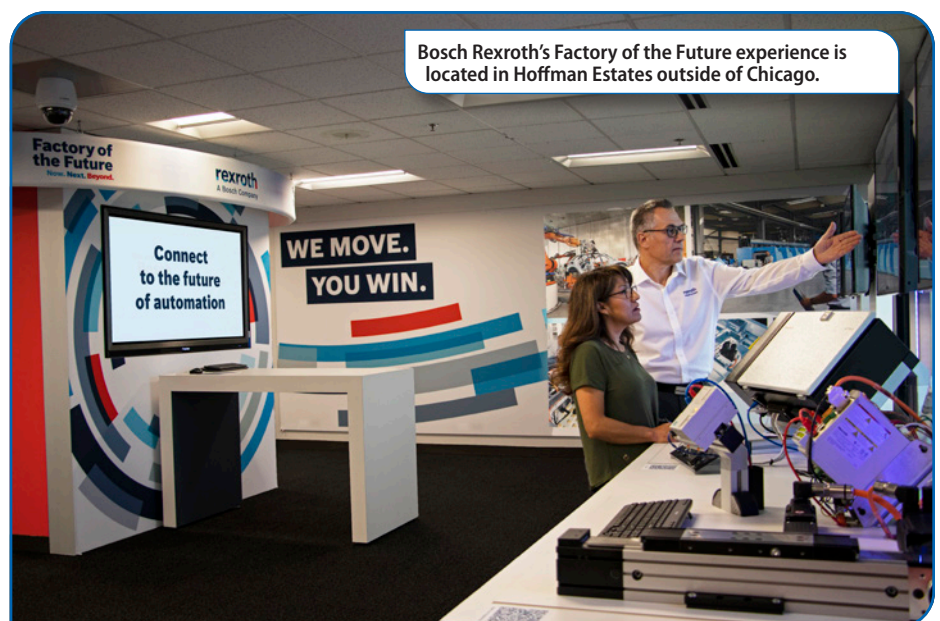
of the Future.

Main machine cabinets are not necessary in the flexible environment of a Factory of the Future. Decentralized intelligent automation components with integrated software perform their tasks independently according to the specifications of higher-level systems. For example, look at distributed intelligence with smart motor-integrated drives:

"We brought together a motor, drive and a sensor in one device - the Rexroth cabinet-free IndraDrive Mi. It's a motor-integrated device that eliminates machine cabinets and enables flexible machine and factory layouts. It also reduces cabling by 90%, energy consumption for cooling, frees up shop floor space leading to a reduced machine footprint. The IndraDrive Mi also has a powerful controller that acts as an intelligent sensor," said Mueller.

These communication/connectivity concepts give visitors an idea of what the smart factory floor will look like in the coming years.

"Our vision of the Factory of the Future offers complete flexibility. The





The flexibility of IndraDrive Mi contributes to cost reductions, reduced cabinet space and reduced energy consumption.

walls, the floor and the ceiling will all be fixed, but everything else will be mobile, with intelligent workspaces where equipment can move around independently. Power will be provided through the floor via inductive charging system,” Cameron said.

Assembly lines will be modular, and machines will move and reorganize themselves.

“In addition, machines and equipment will communicate wirelessly with one another and with other process functions via 5G. The backbone will be able to run a virtual production for planning and optimization. This will result in more flexibility to changing demands, which enables the production of small batches with new benchmarks in the cost-benefit ratio,” added Mueller.

### Real-World Examples

These Factory of the Future concepts are on display at the Bosch Rexroth facility outside of Chicago where visitors receive a backstage pass into how manufacturing communication is changing.

Highlights include:

**ActiveCockpit**—A networked IT application where production planning, quality data management and e-mailing with the software functionality of machines and plants is available directly on the shop floor providing real-time information.

“This puts a new spin on whiteboards by introducing technology so the group can incorporate team meetings, dashboards and visibility directly on the factory floor,” Cameron said.

**Cobots**—Shuttling parts throughout the factory and the introduction of collaborative robots (cobots) ramped up in 2018. Bosch Rexroth expanded

its portfolio of Automatic Production Assistants (APAS). This enables a simple and safe entry into the world of human-robot collaboration. Complete with capacitive sensor skin to avoid collisions, selectable control and the PLC interface mxAutomation, a six-axis robot can capture the strengths of both man and machine in the Factory of the Future.

**Transforming Legacy Products**—This demo in Chicago is a great starting point into IoT. Bosch took old machinery (a welding unit or drill, for example) and modernized it via gateways and sensors. Cameron said this allows you to take older, non-technical equipment and pull data off for operational benefits.

“We can measure vibration, light, humidity, temperature, etc.,” Cameron said. “The idea of taking data off an existing brownfield installation and using it to improve your production



process. Many huge OEMs, for example, have billions of dollars in capital investments and they cannot throw it all away in favor of new products. You have to offer products that adapt to the older equipment. Bosch makes sensors, software and gateways to be able to take this data and push it upstream.”

**Industrial IoT Gateways**—The Gateway is a device that takes in software data from existing motors, drives and controls and has all kinds of interfaces and gives you the ability to communicate with Oracle, Amazon or Bosch Rexroth’s own cloud service.

The idea is a device to push information through to another device. Taking a bunch of temperature, acceleration and machine data and sending this information into the cloud. “You’re not programming anything, you’re not interrupting the machine that was designed ten years ago, the gateway enables access to all kinds of information. This a market we’ve been involved in for a long time,” Cameron said.

**XDK Sensor Technology**—This universal programmable sensor device can be seamlessly integrated into the market’s most challenging IoT applications. There are new versions and new applications for sensing technology to measure data and evaluate productivity coming out regularly. It is also a great tool for IoT prototypes.

**Mechatronics**—Many of these innovations came out of Bosch’s Electrical Group in Chicago as well as the Mechanical Group in Charlotte and are being applied company-wide. Another example of electrical and mechanical principles coming together to solve the many daily challenges of manufacturing.

“The supply chain and operation side of our business is always evolving. Dedicated production lines to make a servo drive or a motor are transforming into production cells. I was used to seeing a dedicated production line for a product and suddenly the steps were all changing,” Cameron added. “This kind of flexible production is happening across all of our divisions.”

## Outside the Factory of the Future

My Chicago visit illustrated the many innovations happening on the shop floor today and tomorrow, but none of these technologies would be possible without the industry coming together to collaborate in areas like automation, security, network communication and IT (*Editor’s Note: See sidebar on page 35*).

“IoT and the realization of the Smart Factory depends on partners in the automation and IT area to make systems compatible and realize solutions. We have several partners, such as cloud providers (Microsoft, Oracle, Amazon), 5G and TSN (multiple automation companies) for example,” Cameron said.

OPC UA over TSN (Time-Sensitive Networking) is an example of how more than 25 participating companies are working together to provide Ethernet-based interoperability soon. “Oracle’s cloud interface and Java platforms are also examples’ of how we have solutions today in our products that are related to other partners,” he added.

Cameron said that technology creates a benefit through application. Applications can be remarkably diverse in manufacturing. Discovering

improvements in new applications helps feed new ideas back to technology ideas. “It’s like a circle,” he said.

## The Multi-Product Operation

Mueller and Cameron said that one of the most sophisticated operations is Bosch Rexroth’s industrial hydraulics manufacturing plant in Bethlehem, PA.

With a large building expansion in 2014, the Bethlehem facility produces valves and manifolds, industrial, mobile and compact controls and provides testing and service support. The distribution and logistics facility supports customers with functions such as shipping, receiving, logistics, quality control, traffic management and accounting. The company’s overall Bethlehem operations also include production for large hydraulic systems and power units. Customers served include those in the construction and agricultural mobile equipment industries, machine tools, presses, plastics machinery, die casting, marine and offshore, pulp and paper, specialty and test machinery, as well as its U.S. distributor network.

“The Bethlehem plant is proud to be one of the first Rexroth facilities worldwide to implement a full-scale manufacturing line using Rexroth’s



The IoT Gateway Rack has the ability to collect legacy PLCs and simple digital and analog I/O to collect data from machines that were manufactured without Industry 4.0 data transfer capabilities, making it the ideal solution for retrofitting older machines.

SafeLogic safely controls the drives for complex machines and plants, such as printing or packaging machines.



rapidly growing Industry 4.0 technology portfolio. The company's new Multi-Product Line (MPL) for assembling hydraulic components combines automated and manual systems with technology that connects operators, machinery and parts to make 34,500 different product variants. The result has been a significant increase in productivity, coupled with invaluable experience gained in the deployment of these forward-thinking technologies," Mueller said.

Within the MPL are a variety of impressive components that work in unison to provide Bethlehem plant management with the tools to keep up with the demands of the fourth industrial revolution. While using the MPL, the Bethlehem plant has experienced an impressive improvement in its production processes. Boasting an overall 2.8-year return on investment, the MPL has benefitted the plant with a 27% cycle-time reduction, 50% downtime-related maintenance and a 50% reduction in floor space.

"More importantly, most of the technology being utilized on the MPL is provided by Bosch divisions and are available for sale to other manufacturing customers," Cameron added.

### A Future of Disruption

New innovations in advanced sensors, data collecting, and the software capable of keeping up with it all, will determine how quick the paradigm will shift in manufacturing. How soon will the shop floor look more science fiction than science? What role will automation, augmented reality, artificial intelligence, and mixed reality play in the manufacture of motors, drives and controls? Bosch Rexroth is not waiting to find out. The company is taking steps in 2020 to prepare its manufacturing facilities as well as its customers for the disruptive technologies coming tomorrow.

It comes as no surprise that the organization is running these initiatives under the motto: Now, Next and Beyond. **PTE**

#### For more information:

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## Bosch Rexroth Examines Mechanical Engineering Requirements with New Automation Platform

Thanks to the open and platform-neutral system architecture, ctrlX AUTOMATION offers the possibility to use future standards such as 5G, OPC UA over TSN, or programming languages yet under development as soon as they are ready for market, according to Dave Cameron, director of sales at Bosch Rexroth – Automation and Electrification Solutions,

"In the future, it will therefore also be possible for machine manufacturers and users to implement new types of automation concepts, whether intelligent AI systems, central server-based solutions, or distributed systems," Cameron said. "More than 30 direct connection options and communication standards offer maximum networking flexibility and enable end-to-end connectivity from field-level up to the cloud."

With this platform, Bosch Rexroth has eradicated the traditional boundaries between machine control systems, IT, and the Internet of Things. Centralized and decentralized automation topologies can now be created flexibly with the scalable platform. Thanks to a Linux real-time operating system, open standards, app programming technology, web-based engineering and a comprehensive IoT connection, ctrlX AUTOMATION reduces the engineering time and effort by 30% to 50%.

Today, mechanical engineering is based on software development. Bosch Rexroth's new ctrlX AUTOMATION platform addresses this market requirement, encompassing the latest engineering software technologies and all PLC and motion tasks. Software functions are combinable in any

number of ways with ready-made, customized and customizable apps. These apps can be created in a variety of programming languages such as C++, script languages such as Python or new graphical languages such as Blockly. This gives machine manufacturers new-found freedom.

The system is set up to allow for personalization and customization. Users decide whether to program in IEC 61131, PLCopen or G-Code, or in other conventional high-level or Internet languages. This liberates machine manufacturers from dependency on the availability of PLC specialists and proprietary systems.

Configuration and commissioning of automation components is completely web-based, eliminating the need to install software. Within minutes of switching on the system, the software is programmed. A completely virtual ctrlX AUTOMATION system environment is available, enabling programming without hardware. System functionalities can be extended at any time via the user's own process functions, apps, and open-source software. In total, ctrlX AUTOMATION cuts the engineering time and effort by 30% to 50%, which significantly reduces time to market for new machines.

This platform is based on a new generation of multicore processors which provide sufficient processing power for almost all automation tasks. These high-performance CPUs

can be integrated into embedded PCs and industrial PCs, or directly into drives. The all-new hardware and software module will cover all automation tasks – from simple control applications and IoT solutions to high-performance motion control.

And what might be one of the more welcoming features of the new automation platform is the lighter, smaller controller and its inherent adaptability. CIMCORP provides automated robotic solutions for the logistics market and is also an early adopter of the ctrlX AUTOMATION system.

Jyrki Anttonen, technology director at CIMCORP, said the company signed an agreement to become a lead customer due to their existing relationship with Bosch Rexroth products and services. As mentioned

earlier, the lighter, smaller controller was an immediate benefit to CIMCORP as well as the open nature of the controller to the IT world, which plays a huge role in future control system architecture.

It gave CIMCORP a unique opportunity to influence the development of ctrlX AUTOMATION. From the outset, they shared system requirements with Bosch Rexroth. By being able to implement the product early, CIMCORP has a head start, which gives the company a significant competitive advantage. It also gives the organization an opportunity to influence the development and offer feedback of ctrlX AUTOMATION through collaboration. **PTE**



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