

Using a concurrent engineering process, DWFritz Automation and Bosch Rexroth worked together to design and install a flexible, high-throughput and fully automated battery production line in record time.



High Throughput Battery Cell Production: How DWFritz and Bosch Rexroth created a custom automation line in record time

From smartphones to electric vehicles, demand for compact, reliable, long-lasting batteries is leading many battery manufacturers to rapidly add new production capacity. But these highly automated battery assembly lines usually take months to develop. Can that time frame be accelerated?

Challenge:

DWFritz needed to develop a complex, automated battery production line for a leading North American battery manufacturer. High speeds, a tight footprint, and an accelerated development time all added to the challenge of finding a reliable partner that could supply the technology and engineering support.

Solution:

Bosch Rexroth worked in partnership with the DWFritz engineering team to develop a system that used a wide array of technologies and systems from Rexroth to create the new battery production line.

DWFritz Automation (Wilsonville, OR – www.dwfritz.com), a leading global provider of engineered-to-order precision automation, metrology and inspection solutions for advanced manufacturing, recently delivered a new, flexible, high-throughput and fully automated battery production line for a leading North American battery manufacturer – in record time.

“At DWFritz, we talk in terms of microns and milliseconds,” said Chris Povich, the company’s Vice President of Sales. “The types of manufacturing challenges that we solve for our customers require high speeds, advanced material handling, process automation, and very high precision. These are some of the key capabilities we bring to the table.”

With the complexity of the project and short development time, DWFritz sought a strategic partner that could provide expertise in multiple technologies while operating in a concurrent engineering environment, allowing for rapid design iteration and accelerated project execution. They chose Bosch Rexroth.

PARTNERING TO DELIVER IN RECORD TIME

No matter what size or form factor, battery manufacturing is a complex, multistep process that brings together dissimilar materials to form the battery’s cathode and anode, then combining them with the conductor into a finished package. Today’s batteries are becoming smaller with higher energy densities. Extremely tight assembly tolerances, higher rates of throughput and real-time inspection, data capture and communication with machine and plant-level control systems were all key requirements of the solution DWFritz and Bosch Rexroth were tasked with building.

According to Povich, several key design and operating requirements helped drive the decision to partner with Bosch Rexroth for the project. “The line had to operate at very high speeds,” he said. “Space was also a challenge. Even though the line is more than a hundred feet long, it had to be designed to fit into a very tight footprint. And the motion platform had to handle very robust motion control demands – one system alone had in excess of 50 axes of motion.”

One of the biggest challenges was time, according to Mukesh Dulani, President, DWFritz. “In the past we would have used several different suppliers, but just to start the collaboration between different suppliers in this case would have taken us at least 10 to 15 weeks,” he said. “For this project, we only had 12 weeks of design and engineering time and eight weeks for procurement, so we had to work with a partner like Bosch Rexroth who could supply the technology and the engineering support for us to be successful.”

For Bosch Rexroth, partnering with leading machine builders and integrators is a critical step in making the Factory of the Future a reality today, according to Matthias Aberle, Bosch Rexroth North America Senior Vice President for Manufacturing, Engineering and Factory Automation. “The challenge we all face is that customers want better results, with more open and innovative systems that move real-time machine information from the shop floor to where it can be used more effectively,” he said. “To do that, we’re developing key partnerships with technology stakeholders like DWFritz so that the combined strengths of our organizations will drive major transformations in the automation industry.”

Engineering a complex, multi-technology production line Bosch Rexroth contributed a wide array of technologies and systems to create the new battery production line. These included:

- Multiple conveyor systems to transport batteries within and between production cells
- Precision linear motion modules used in gantry-style handling systems
- [Aluminum structural framing](#)
- A full suite of advanced motion control and drive systems, including one of the first implementations of the ground-breaking new Rexroth [ctrlX AUTOMATION](#) control platform



Using the Rexroth ctrlX AUTOMATION platform and its ctrlX CORE controller not only made this project successful, but it enabled the customer to build future production lines using the same software and hardware platform.

“One of our most important goals was to have an open machine control architecture so that our customer’s servers could directly query the machine and get real-time data,” said Dulani. “Using the Rexroth ctrlX AUTOMATION platform and its [ctrlX CORE controller](#) not only made this project successful, but it enabled our customer to build future production lines using the same software and hardware platform.” Rexroth’s ctrlX AUTOMATION platform

encompasses both hardware and software. With a Linux-based real-time operating system, consistently open architecture and web-based engineering, it enables users to create, add or share automation functions via an app – or even purchase them from the Bosch Rexroth [ctrIX WORLD](#) app store – making automation as easy as using a smartphone.

In addition, Bosch Rexroth’s controllers can also manage third-party field devices through a deterministic real-time communication platform, enabling support of advanced camming solutions and synchronizing the production modules on the same real-time control clock. The ease of use and openness of ctrIX AUTOMATION were vital for the team to complete this complex, cooperative project within the time frame. The Rexroth platform supports the free choice of programming languages instead of being limited to proprietary platforms. Web-based system configuration also allows fast and simple start-up without the need to install software. And a completely virtual development environment enabled the team to create a “digital twin” of the communication platform between MES and automation controllers, saving an enormous amount of time.

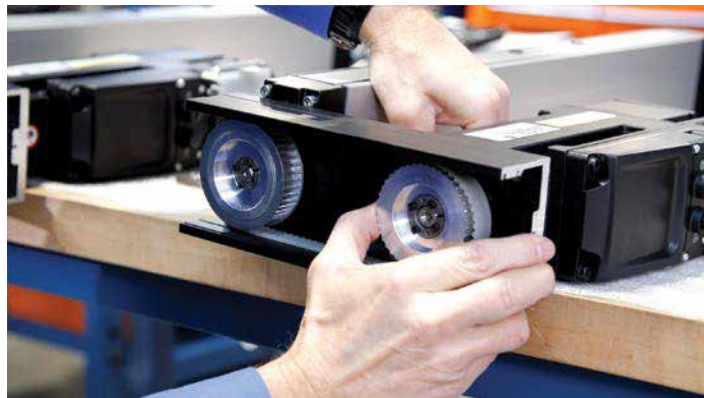
“The ability to use a digital twin gave the DWFritz engineers a software platform they could work on immediately,” said Dave Hull, Bosch Rexroth Regional Vice President. “Months before they got the hardware, they were testing all of its systems, how it was going to work and how it would interface with the battery manufacturer’s MES system. It gave us a great head start.”

REXROTH TECHNOLOGY ENABLES PRECISE MOTION, HIGH THROUGHPUT

DWFritz built the production cells for the battery line around their innovative DWFritz Flexible Platform DFP5000 assembly cell. It’s a flexible modular platform that can be custom-configured with the controls, servo drives and transport in-feeds for specific processes. According to Martin Bamberger, Staff Engineer for DWFritz, precision kinematic tools were essential elements for multiple production cells to carry out a wide range of assembly and inspection tasks. “Correctly aligning all the components with tolerances between 20 to 50 microns in a battery, as it is assembled and processed at high throughput rates, requires precision components,” he said.

To provide the required precision and functional efficiency for these kinematics, the Rexroth [CKK compact linear modules](#) were selected. “Our modules are very compact and feature high accuracy with repeatability in the five-micron range,” said Rexroth Sales Manager Mike Ziencina. The modules were combined to create a variety of

kinematic solutions, such as Cartesian robot pick-and-place systems, incorporated into the DFP5000 cell.

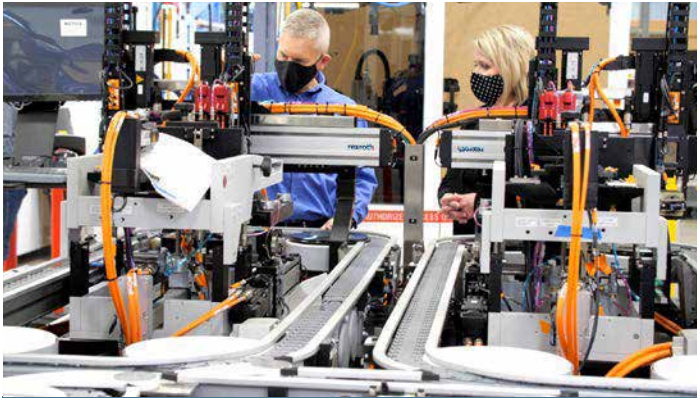


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Another key technology contribution from Bosch Rexroth was the compact [IndraDrive Mi motor-integrated servo system](#), which was used on web handling stations where the initial battery production phase takes place. The IndraDrive Mi is a cabinet-free system that combines the servo drive and motor in a single package and offers connectivity flexibility based on the application requirements. This enabled the team to integrate all electrical drive components directly into the machine, saving floor space and setup time.

With the speed and complexity of this production line, safety was also a critical consideration. Bosch Rexroth provided a full suite of state-of-the-art [machine safety solutions](#), including integrated Safety PLC with automation controllers, built-in advanced SafeMotion safety technology in the servo drives and Safety I/O and integrated safety communications support with PROFIsafe.

For product handling, Bosch Rexroth conveyors were key to the project’s success. To determine which conveyor offerings were the most suitable to use, the team considered the size of the product being manufactured, its weight, the throughput speeds and stopping accuracy required, among other criteria. In the end, the Rexroth [VarioFlow plus conveyor](#), configured as a pallet-based solution, provided the best platform. VarioFlow plus is a flexible, modular plastic chain conveyor, with the design versatility to move high-volume products horizontally, vertically, around obstacles or in other configurations. Workpiece pallets can be used with VarioFlow plus to convey products in applications where positioning or higher precision is needed.



The Rexroth VarioFlow plus flexible chain conveyor system, configured with workpiece pallets, was ideal for the size of the product being manufactured, its weight and the throughput speeds and stopping accuracy required.

Because the assembly cells are so tightly packed with automation components, the VarioFlow plus system allowed for many processes to occur, while still maintaining the pallet position on the conveyor system through each of the tools. In addition, the VarioFlow plus made it easier to create a recirculating system to return the empty pallets back to the beginning and start the process over again, saving valuable floor space. Bosch Rexroth also worked closely with DWFritz to enable an open architecture for the manufacturing line.

CONCURRENT DESIGN PARTNERSHIPS ARE THE FUTURE OF AUTOMATION

The engineering process and development partnership established in this project – with system design, programming and component acquisition and integration organized to occur in tight, overlapping time frames – will become the standard approach for complex automation projects going forward – if the right partners can work together the way DWFritz and Bosch Rexroth did.

“From the beginning, Bosch was working in partnership with our engineering team as we were developing the technical concept,” said DWFritz’s Povich. “When we were awarded the project, immediately a full team from both companies came together to work hard and solve the customer’s challenges.” For Bosch Rexroth, the success of this project not only laid the groundwork for further projects with DWFritz, but it also presented a model of how the vision for Industry 4.0 automation in manufacturing can become a reality.

“This partnership showed real, concrete steps to achieve that,” said Rexroth’s Dave Hull. “We’re thrilled to work with a company like DWFritz, where we can demonstrate how to shorten lead times, make the customer successful and deliver a solution that meets their needs now and for the future.”

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