The MPL has helped the Bethlehem plant to achieve quality improvements and additional productivity.

CASE STUDY

Bosch Rexroth Improves Productivity with New Multi-Product Line

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Challenge:

Engineer a full-scale manufacturing line to improve processes within Bosch Rexroth's facility in Bethlehem, PA.

Solution:

Implement Rexroth MPL to combine automated and manual systems throughout the industrial hydraulics plant.

Results:

- **27 percent cycle-time reduction**
- **50 percent downtime-related maintenance reduction**
- **50 percent floor space reduction**

Overview

As one of the world's leading manufacturing companies, Bosch strives to be both a lead provider and a lead user of Industry 4.0 technologies. Worldwide, the company has more than 70 Internet of Things projects running in a variety of industries and applications. Bosch Rexroth, the company's drive and control technology business, engineers many of the Industry 4.0 technologies used in Bosch manufacturing facilities, including its own. 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.

One of the most sophisticated operations is Bosch Rexroth's industrial hydraulics plant in Bethlehem, PA. The Bethlehem plant is proud to be one of the first Rexroth facilities worldwide to implement a full-scale manufacturing line using Rexroth's rapidly-growing Industry 4.0 technology portfolio. The new Multi-Product Line (MPL) mixes 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. Within the MPL are a variety of impressive components that work in unison to provide Bethlehem with the tools to keep up with the demands of the fourth industrial revolution.

Manufacturing Execution System

The Manufacturing Execution System (MES) is centrally located in the plant and is responsible for collecting, filtering and continually displaying production data. Since the MES is consistently running, it plays a crucial role in managing the MPL by providing operators and managers with immediate

status updates from all areas of the line. The MPL uses Bosch Rexroth's ActiveCockpit to visualize production data from every corner of the plant on a single 65-inch screen. Not standing next to the ActiveCockpit? Rexroth employees can still access the information from mobile devices, laptops or tablets as part of Rexroth's efforts to go paperless and eliminate administrative work for daily floor management. Since operators and managers can access the information from anywhere in the plant, ActiveCockpit can alert them of a problem, allowing them to take corrective action from anywhere in the plant, reducing downtime and minimizing error. In Bethlehem, employees use the ActiveCockpit to meet for 15 minutes at the beginning of every shift to review the previous day's data and plan out the day accordingly. ActiveCockpit's built-in functionality includes the ability to run meetings, including attendance, record and store meeting minutes and sending the notes to absent attendees. What makes ActiveCockpit and its Industry 4.0-related products flexible is that it's completely configurable for unique applications.

Radio Frequency Identification Tags

Industry 4.0 at Rexroth is about using automated technology to support the worker in their everyday tasks. The key to doing this is customization. Each worker on the MPL has a name tag with an embedded Radio Frequency Identification Tag (RFID). The individual workstations throughout the MPL are programmed to read the RFID tags and adapt the workplace to their skills and preferences. This includes ergonomic initiatives such as height-adjustable benches to providing instructions based on experience. The RFID tag can connect with workstations to initiate material requests or assembly instruction on behalf of the worker, allowing employees to focus on creating high-quality products. Using RFID tags, Rexroth ensures that each employee can work in a space designed specifically for their needs, increasing worker productivity and comfort. The same technology that customizes employee work processes assists with identifying product variants as they come down the line. All products made on the MPL have a unique identification tag. As the products move down the line, the product's RFID tag is closely monitored by the production control system to trigger replenishment of components when

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necessary. Additionally, product carts are identified by RFID tags and alert Automatic Guided Vehicles (AGV) to automatically pick up materials for the next production cycle. In support of the efforts of Industry 4.0 and Rexroth's dedication to worker safety, RFID tags have been essential to ensuring high-quality products are leaving Rexroth's doors while protecting the workers.

Light Guided System
Once the workstation has identified the worker with their personalized RFID tag, the instructions for assembling the current product are beamed onto the station with a Light Guided System (LGS). Since the workstations are customized to the individual, the LGS displays the instruction with the level of detail appropriate for the worker's level of experience. When executing a task that requires assembling, the highest risk from a quality perspective is whether the right component will make it to the right spot at the right moment in assembly. To combat this challenge, Rexroth's LGS is equipped with a camera and sensors to confirm that operators move forward with the operation per the standard. If the camera detects that the operator is about to use the wrong piece in the wrong sequence, the LGS prohibits movement

further in the instructions when it senses the inaccuracy. With its built-in scanners, the LGS has the ability to read the RFID tags of products, activating the instructions for that product to be displayed.

Production Performance Manager
In contrast to the MES, which is mainly utilized for administrative documentation, the Production Performance Manager (PPM), a software solution developed by Bosch Software Innovations, is installed in the MPL to monitor manufacturing processes. The PPM is designed to help users to visualize data in real time and has the capacity to track the many sensors integrated into the MPL, allowing it to measure features such as temperature, flow, pressure, vibrations, torque, sounds, and other operating characteristics. Like the MES, the PPM is customizable to a plant's unique application. With the PPM, users can apply pre-determined thresholds, or "rules," to the data to ensure the plant is running efficiently. If a "rule" is crossed, the PPM can automatically issue a ticket and alert the appropriate employee with the right qualification and responsibility to deal with the affected machine for an immediate resolution. For example, if the PPM senses that the hydraulic filters are clogged and its data show performance levels are below the

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threshold of a properly-functioning filter, an alert will be automatically issued to ensure quick action on the issue. The ultimate goal is to get ahead of the maintenance process, minimize downtime and ensure the equipment is always performing at its peak. In conjunction with a Maintenance Support System, the PPM can also provide diagnostics and recommend the ideal repair strategy from its knowledge database to maintain continuous operation.

Improvidus

The experience gained from the MPL encouraged the development of the Improvidus software innovation. The Bethlehem plant implemented Improvidus in the MPL to optimize the productivity of the line. Improvidus is a free software solution from Bosch that allows operators to visualize the Overall Equipment Effectiveness (OEE) of their facilities by measuring the availability, performance, and quality of each production cycle and clearly portray the data to reveal deviations. By identifying deviations, and more importantly, what caused the deviation, Improvidus allows its users to create customized solutions for the unique operational challenges of the application.

"**There's not a one-size-fits-all solution.** Different solutions will have different use cases in different business types and that's the value Rexroth can provide with Improvidus and connected industry consultants."

- **Keith Weigand,** Connected Industry Consultant at Bosch Rexroth

With Improvidus and its array of customizable features, users can embrace the distinctness of their application and tailor their solutions accordingly. For more information on OEE and Improvidus, visit Rexroth's YouTube channel and watch our video series explaining the different types of deviations you can experience in your facility.

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Conclusion

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 percent cycle-time reduction, 50 percent downtime-related maintenance and a 50 percent reduction in floor space. More importantly, most of the technology being utilized on the MPL is provided by Bosch divisions and is available for sale to manufacturers. Manfred Hahn, Vice President – Technical Plant Manager, Bosch Rexroth says, "We wanted to achieve quality improvements and additional productivity. With the technology we used and added to our multi-product line this is exactly what we needed to meet those objectives." By utilizing the multi-product line in our Bethlehem, PA facility, we've gained invaluable firsthand experience on connected technology's ability to enhance productivity and efficiency in assembly operations, parts supply, worker guidance and quality control. Learn more about the MPL and see the different components in action with our recent video.

Do you have an application worthy of a case study?

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