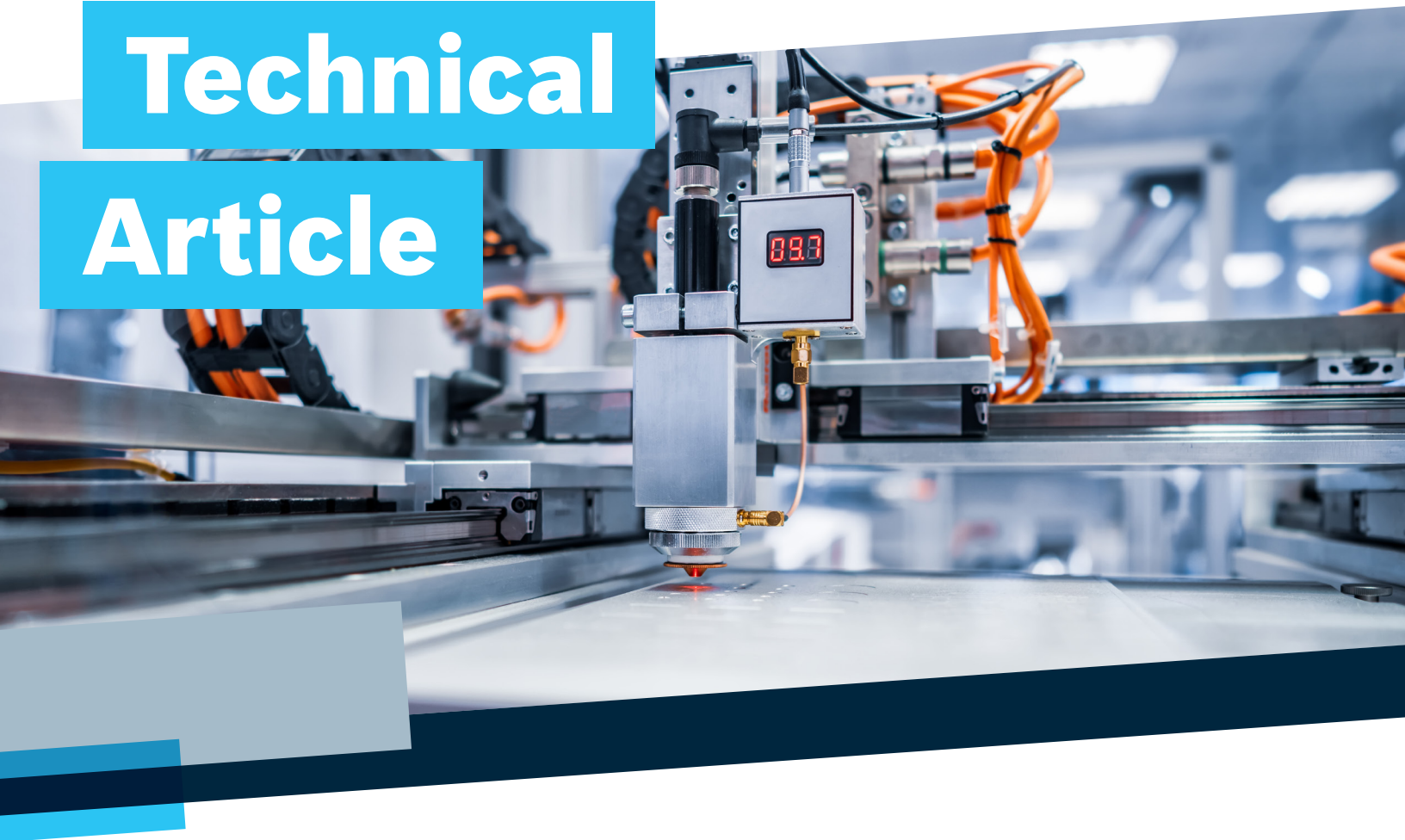


Technical Article



The Value of Mechatronic Subassemblies

Strategies for building custom linear motion solutions for Industry 4.0 manufacturing systems

Today's manufacturing systems need to move a dizzying array of materials and components through multiple, complex processing and assembly steps. Costly, lightweight electronics need to be handled with extreme care while being placed by actuators in precise positions. Actuators and gantry systems lift heavier devices through X, Y and Z axes of motion in a constantly moving flow of goods that transforms raw inputs into highly valued, finished products ready for shipping.

Mechatronic subassemblies play an integral and valuable role in this nonstop manufacturing ballet. Through smart, well-engineered integration of linear components and electronic motors, controls and sensors, mechatronics provide complete solutions that make it easier for machine builders to quickly build complex manufacturing systems for demanding industries ranging from pharmaceutical packaging to semiconductor fabs.

Key Insights & Considerations

- **Buyer concentration, globalization of the automation end-user, concentration on core competencies and the need for integration of multiple functions are all industry drivers causing suppliers to seek quality single-source solutions.**
- **When selecting mechatronics suppliers, it's important to assess both products offered and the organization's engineering resources, experience and capabilities.**
- **Successful suppliers continually design, prototype and create complex linear motion subassemblies to meet a range of applications and systems.**
- **The point of contact, technical expertise, resources, costs and development timelines should all be considered for your mechatronics solution.**

Key industry drivers

Automation machine builders and end-users face constant pressure to improve both the flexibility and cost-effectiveness of the machines they build and use. These drivers are leading the industry to seek factory automation suppliers who have the resources to provide single-source solutions that are global in scope:

- **Buyer concentration:** Engineering staff and purchasing agents at machine builder OEMs are moving toward more single-source suppliers for many machine components. Instead of dozens or even hundreds of suppliers for ball rails, linear modules, aluminum framing, conveyor technology and drive systems, companies are seeking one company that can supply, engineer and integrate as many components as possible into complete solutions.
- **Globalization of the automation end-user:** The dispersal of global supply chains is leading many manufacturers to require OEMs and the companies

that supply them to be able to support their products, from engineering through delivery and long-term maintenance – in many more locations across the globe.

- **OEMs and end-users concentrate on core competencies:** Many OEMs that build highly specialized machines, from bottling equipment to semiconductor fabrication tools, are concentrating valuable engineering resources on optimizing the performance of their machines' core functions and outsourcing the creation of the subsidiary motion and transport functions in their machines to suppliers with proven expertise in these systems.
- **Need for integration of control and mechanical functions:** Rather than treating motion control and linear motion technologies as two separate disciplines, many machine builders and end-users are recognizing that there are economies of scale and design advantages from adopting a mechatronics approach that combines both technologies into a complete subassembly solutions approach.

Broad range of capabilities

Selecting the right automation supplier calls for a full understanding of that company's capabilities. It starts with making sure they possess the requisite portfolio of products to build high-performance linear motion and material transport subassemblies.

But product in and of itself is not enough: Mechatronics is an engineering and systems integration discipline. It's equally important to assess the supplier's engineering resources and experience, as well as validate their manufacturing and assembly capabilities. The performance of the mechatronic system – its efficiency, reliability, modularity, ease of integration into the larger machine and long-term maintainability – will depend upon the performance and capabilities of the mechatronics supplier.

Bosch Rexroth is uniquely positioned to satisfy the emerging requirements of subassemblies. For decades we have been investing in developing an industry-leading portfolio of both linear motion and motion control products, targeting the needs of some of the most cutting-edge automation machine builders and end-users in a wide range of industries. In addition, we also design and build a full range of assembly technology products, from aluminum structural framing and manual production systems to a complete line of conveyor systems.

Bosch Rexroth's strength in factory automation represents more than just great products proven in thousands of installed systems worldwide. We combine those products with advanced mechatronic engineering expertise. This includes deep insights into the principles and design requirements for sizing, selecting and integrating the right kinds of linear motion equipment – linear guides, ball screw drives and linear modules – with extensive experience specifying and programming complete motion control systems, including both drive-based and PLC-based automation.

To ensure that our mechatronic subassemblies satisfy application requirements, Bosch Rexroth not only works with customers to define test criteria but also utilizes state-of-the-art production equipment and quality processes to ensure specifications are being met.

These include:

- Precision assembly workstations that follow lean manufacturing processes built around the Bosch Production System and continuous improvement processes (CIP)
- Product qualification plans that feature documented controls related to manufacturing
- Standardized Supplier Quality Assessment (SSQA) programs that include complete enterprise audits
- Reliability testing and laser inspection of finished subassemblies
- Major industry certifications, including ISO 9001, ISO 14001 and ISO 18001

These capabilities uniquely equip Bosch Rexroth to collaborate with both machine builders and their end-user customers to develop solutions that fully satisfy machine performance and manufacturing requirements. These capabilities also ensure that Bosch Rexroth can supply a high number of mechatronic subassemblies without sacrificing quality or functionality.

“To ensure that our mechatronic subassemblies satisfy all requirements, Bosch Rexroth has created a complete subassembly configuration and testing operation with state-of-the-art production equipment and quality processes.”





To ensure that their systems are prepared for a wide range of applications, successful automation suppliers continually develop new linear motion subassemblies.

Precision solutions to complex challenges

As a mechatronics supplier, Bosch Rexroth has the capacity to provide two kinds of solutions to subassembly challenges: standard, ready-to-build systems and custom subassemblies.

Many companies seek solutions for transport of materials between different lines. Our EasyHandling system provides a complete platform for the easy design, construction and commissioning of Cartesian motion robots (also known as linear robots). The system combines open, user-friendly programming environments with precise and reliable linear componentry to create the most accessible, easy-to-use Cartesian motion robot.

For more complex and unique projects requiring high volume production, Bosch Rexroth develops custom solutions that integrate a range of linear motion and controls systems into complete subassemblies. These are developed in close collaboration with machine builders, and in many cases are designed to solve challenges associated with precision motion, end-position placement accuracy and smooth, virtually vibration-free transport between process points in complex manufacturing and fabrication systems.

Bosch Rexroth is continually designing, prototyping and/or manufacturing complex linear motion subassemblies for a range of demanding applications, including semiconductor fabrication tools and medical systems. Key examples of projects include:



Custom subassemblies, such as a wafer lift assembly for semiconductor fabrication, integrate customer-specific features into a design that, for example, make it easier to mount and implement to the machine.

Wafer lift assembly

- ▶ **Challenge:** Tool designer and end-user manufacturer wanted much smoother motion when moving costly, delicate semiconductor wafers between two process points
- ▶ **Rexroth role:** Create a cost-optimized subassembly design incorporating ball screw, ball rail, and servo motor, create fully working prototype and testing at machine builder site and assure efficient integration into machine envelope
- ▶ **Project results:**
 - Mass wafer lift allows production of thousands of subassemblies tested and ready for installation
 - Cost reduction of ~30% compared to acquiring and integrating discrete components
 - Highly reliable performance for greater than 5 million cycles

Wafer spin

- ▶ **Challenge:** Wafer cleaning tool builder needed to reduce costs and improve the reliability of a fixture that lifts and spins a silicon wafer during semiconductor processing
- ▶ **Rexroth role:** Develop a prototype lift assembly and supply a complete motion control platform to control and drive the subassembly to extremely tight motion tolerances
- ▶ **Project results:**
 - Developed complete motion control architecture and controls panel, incorporating advanced Rexroth MPC controller and IndraDrive Cs drives to control both lift and spin motions of client-manufactured subassembly
 - Complete drop-in hardware and software platform delivered as single-source subassembly for easier integration into overall tool
 - Created application software to interface wafer spin subassembly to overall machine controls platform
 - Achieved improved performance and reduced costs compared to previous design

Medical diagnostic tool

- ▶ **Challenge:** Create linear transport subassembly for moving samples within medical diagnostic tools safely and efficiently
- ▶ **Rexroth role:** Combined Rexroth ball screw, linear rails and motor into compact subassembly engineered precisely to fit into existing machine envelope
- ▶ **Project results:**
 - Designed, tested and manufactured subassembly to fit into tight machine spaces
 - Cost-effective subassembly development enabled medical diagnostic tool builder to concentrate valuable engineering resources on core competencies associated with medical equipment

In these and multiple other mechatronic solutions, one key advantage Bosch Rexroth offers is agile engineering. We leverage our ability to quickly and cost-effectively integrate customer specific features into a design that makes it much easier to mount subassemblies to machine frames, without interfering with overall machine performance or requiring machine frame redesign to fit the subassemblies into existing machine envelopes.

And our experience working with the fast pace of semiconductor tool manufacturers, who often require extreme end-point accuracy in motion sequences as well as extremely smooth motion, enable us to easily satisfy complex motion control requirements. This is the result of our combined experience programming motion control platforms and Rexroth's ability to manufacture ball screws, ball rails and linear modules to deliver accurate, repeatable motion performance that often exceeds standard tolerances from other manufacturers.

Choosing the right solution

Using a subassembly approach to create linear motion and transport systems in complex manufacturing machines and platforms can give automation OEMs a competitive edge. It can allow you to concentrate engineering resources on core competencies while giving the experts in mechatronic systems the responsibility for providing complete solutions ready for integration into your machines.

When selecting a mechatronic subassembly supplier, consider companies like Bosch Rexroth that have both the resources and expertise to fully support your business requirements. These include:

Single point of contact

- Contract and logistics
- Engineering and responsibility for system performance
- Service

Technical expertise

- Proven portfolio of linear and motion control products
- Engineering resources and expertise in automation and motion control
- Integration and manufacturing capability of multiple technologies

Global/local resources

- Global project management and support
- Long-term stability and technical expertise available globally

Cost savings

- Cost-optimized solutions
- Ability to demonstrate lower total cost of ownership

Compressed product development timeline

- Collaborative engineering
- Proven, in-house engineering, fabrication, integration and testing capabilities

Do you have technical advice worthy of an article?

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For more information on how Bosch Rexroth can supply mechatronic subassemblies for your next project, contact:

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