Large-Part Machining Transformed with High-Precision Robotics

Machining large components requires a large CNC machine tool, right? Well, not always. What happens when the required tolerance is measured in tenths rather than hundredths of a millimeter? For some applications, investing in a CNC machine results in paying for unnecessary capability. Fives High Precision Machines (Fives HPM) provides a different and more effective approach with the Liné Machines RoboTDM, a high-precision robotic machining solution that brings direct milling, trimming, and drilling to large workpieces.



With RoboTDM, set up is quicker and programming is easier, all while negating the cost and footprint of a large CNC machine.

Not every large component demands ultra-high precision. For applications where tolerances down to approximately 0.1 mm are acceptable, the Liné Machines RoboTDM provides a highly attractive alternative. By equipping an industrial robot with a specialized end effector incorporating a spindle, toolholder, and cutter, the system can perform material removal directly on the workpiece.

The result is a flexible approach to large-part machining that reduces equipment requirements while delivering significant productivity gains. Potential operations include metal face milling or deburring, such as removing burrs from castings and trimming excess weld beads. It could also include drilling pilot holes on large aerospace panels or automotive body parts, as well as trimming, routing, drilling, edge contouring, and pocketing on large composite or thermoplastic fabrications.

Matching the Machine to the Tolerance

Using a CNC machine tool for these applications will typically involve substantial set-up time and programming. The Liné Machines RoboTDM, part of Fives' Material Removal (MR) business line, changes the equation. Rather than bringing the entire component into a large machine envelope, the machining capability is brought directly to the workpiece.

For suitable applications, this strategy can deliver major advantages in flexibility, cost and cycle time. A Fives' R&D project and development trials spanning several years have demonstrated cycle time reductions of up to 70% in trimming and milling, with some individual applications achieving even greater savings.

The technology therefore addresses a simple but increasingly important manufacturing question: does the application actually necessitate a large CNC machine, or does it simply require a reliable and accurate way of putting a cutting tool in the right place?

Closing the Accuracy Gap

Industrial robots have traditionally struggled to answer that question. Their inherent flexibility comes at the expense of positional accuracy, with conventional systems typically achieving tolerances of around 0.3 mm - insufficient for many machining applications.



The development work for RoboTDM focused on closing the accuracy gap through high-precision robotic machining (HPRM). Here, robot calibration techniques, together with advanced look-ahead and motion-planning algorithms, allow the processing of programs containing more than one million points without the latency that can otherwise compromise robot motion. The result is smoother trajectory execution, supporting multi-axis contouring and complex machining operations in a way that is more closely comparable with CNC machining.

RoboTDM can reduce machining deviation up to 100 µm (0.1 mm). This represents a threefold improvement over conventional robotic accuracy and changes the range of applications for which robotic machining becomes viable.

A Robot Built for Machining

It is possible to configure the machining end effector with different spindle sizes, power ratings, torque, and speed according to the task. Available systems can provide spindle power of up to 125 kW, torque of up to 80 Nm, and speeds reaching 30,000 rpm, with HSK A63, HSK F63, or HSK A100 taper toolholders.

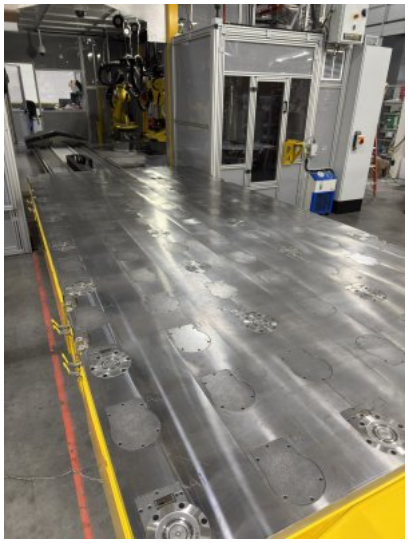
In addition, RoboTDM can incorporate automatic tool changing, tool measurement, tool-breakage detection, and part probing, while a vision system can support drilling applications.

However, machining is not the only technology suitable for integration. RoboTDM systems are also configurable for processes including waterjet cutting, laser profiling, and ultrasonic cutting.

Large-Scale Flexibility

The physical flexibility of a robot is again valuable when manufacturing components that are too large or awkward to justify moving through a conventional machine tool.

RoboTDM is configurable with multiple workstations and customized peripheral equipment, while its relatively modest foundation requirements simplify installation compared with a large CNC machine tool. This factor can prove particularly attractive in sectors such as aerospace, defense, maritime, and energy, where component dimensions can be substantial and production requirements vary considerably.



Of course, the technology does not pretend to solve every machining challenge. Where tolerances tighter than 0.1 mm are necessary, a high-precision CNC machine remains the appropriate choice. In this respect, RoboTDM is complementary to Liné Machines' and the wider Fives HPM portfolio of high-precision machine tools.

Precision at Scale Takes Different Forms
RoboTDM represents another interpretation of Fives HPM's ‘precision at scale’ cross-brand mantra. In this case, scale means finding a smarter way to manufacture large components while applying precisely the level of accuracy demanded by the application.

The technology also illustrates the value of bringing specialist capabilities of many individual brands together under the newly unified Fives HPM banner. Here, the Liné Machines brand contributes decades of expertise and pioneering in large-scale milling and material-removal processes.

Engineered for the Application
The development of RoboTDM originated directly from the requirements of customers. It reflects Fives HPM's approach to engineering solutions around specific manufacturing challenges rather than forcing applications to fit standard equipment.

Notably, Fives Liné Machines Inc, now parts of Fives HPM, has had a strong presence on the North American continent for almost 50 years with its facility in Granby, Quebec, Canada. The manufacturing plant produces both Liné CNC machine tools and robotic solutions, including the RoboTDM. The site also provides access to support activities that include engineering, integration, automation, service, training, and more across equipment lifecycles.

Ultimately, by achieving a level of accuracy that is sufficient for a range of large-part applications, RoboTDM gives manufacturers another option between conventional robotics and the cost of a large CNC machine tools. For the right component, it can mean lower capital investment, simpler installation, greater flexibility, and dramatically shorter cycle times.

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About Fives

An international leader in industrial engineering, Fives designs and manufactures machines, process equipment and production lines for the world’s largest industrial groups, serving various sectors: Intralogistics (airport, e-commerce, distribution), Metals (steel, aluminum), Cement and Minerals, energy (nuclear, combustion, wind power), Aerospace, Defense, Automotive…

Fives is always one innovation ahead thanks to its ability to anticipate customer needs. By responding to the specificities of each market locally, Fives combines economic and environmental performance in 25 countries thanks to over 9,200 employees. In 2024, Fives reached a turnover close to €2.3 billion.

www.fivesgroup.com

Fives
High Precision Machines Division
Lola GIBSON
Phone: +1 (440) 709 0748
lola.gibson@fivesgroup.com
https://www.fivesgroup.com/