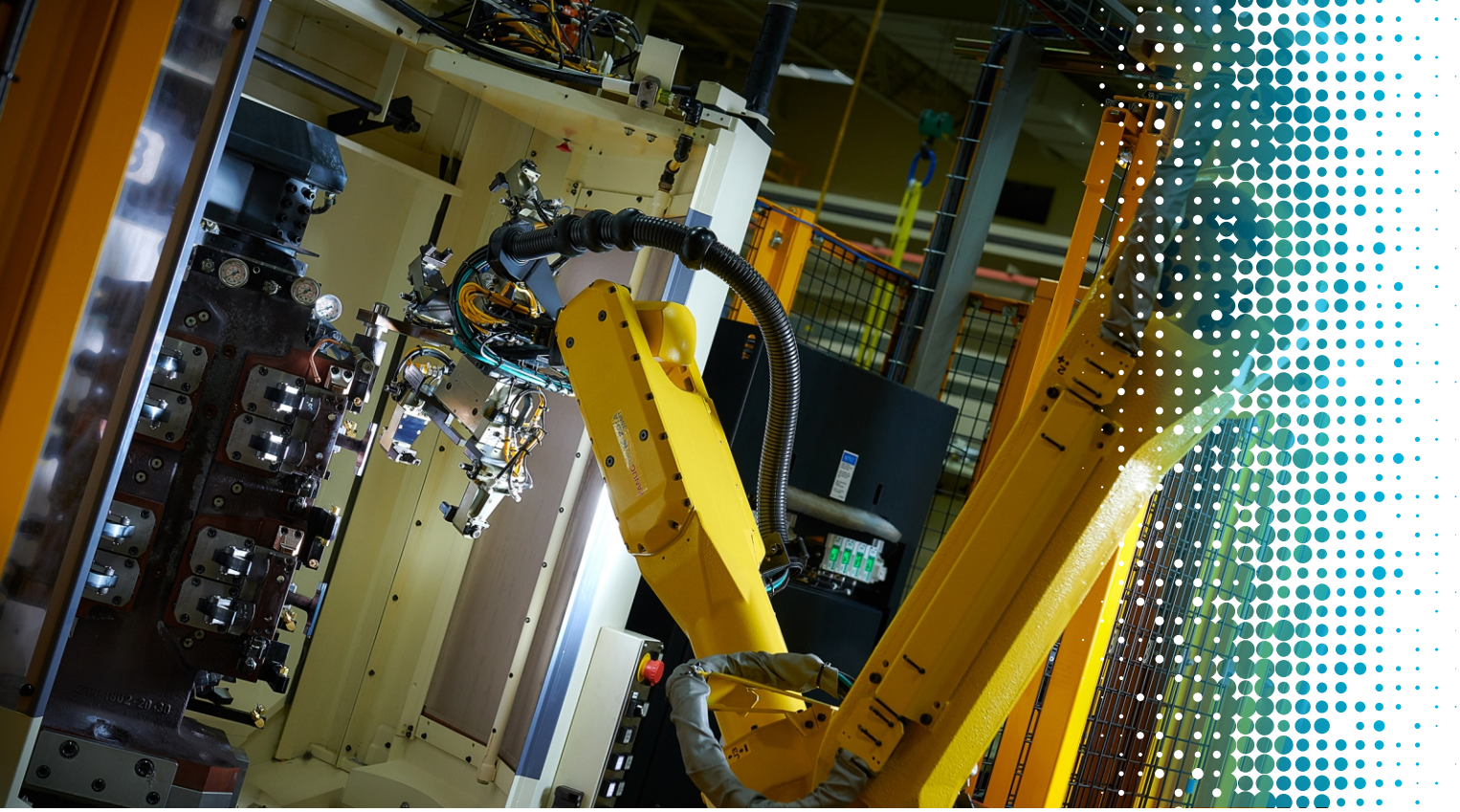


Integration Services

MAKINO
Promise of Performance

Single Source Advantage

Makino is uniquely qualified to be your single source for developing the most effective solution that will reduce the cost of machining a part.

Makino Integration Services takes "prime contractor responsibility" for the complete integration of machining technologies, third-party equipment, material handling, application engineering, fixtures, on-time delivery, on-site installation, successful test runs, training and post-production support.

To remain competitive in today's market, manufacturers must reduce labor costs, increase throughput, ensure and even enhance part quality, and yet remain flexible enough to adapt to quickly changing volumes, designs and products. No other manufacturing process can achieve all of these goals as well as automation. Makino Integration Services evolved directly from the ever-growing need for seamless automation and the fierce pricing pressures manufacturers face in the global economy.

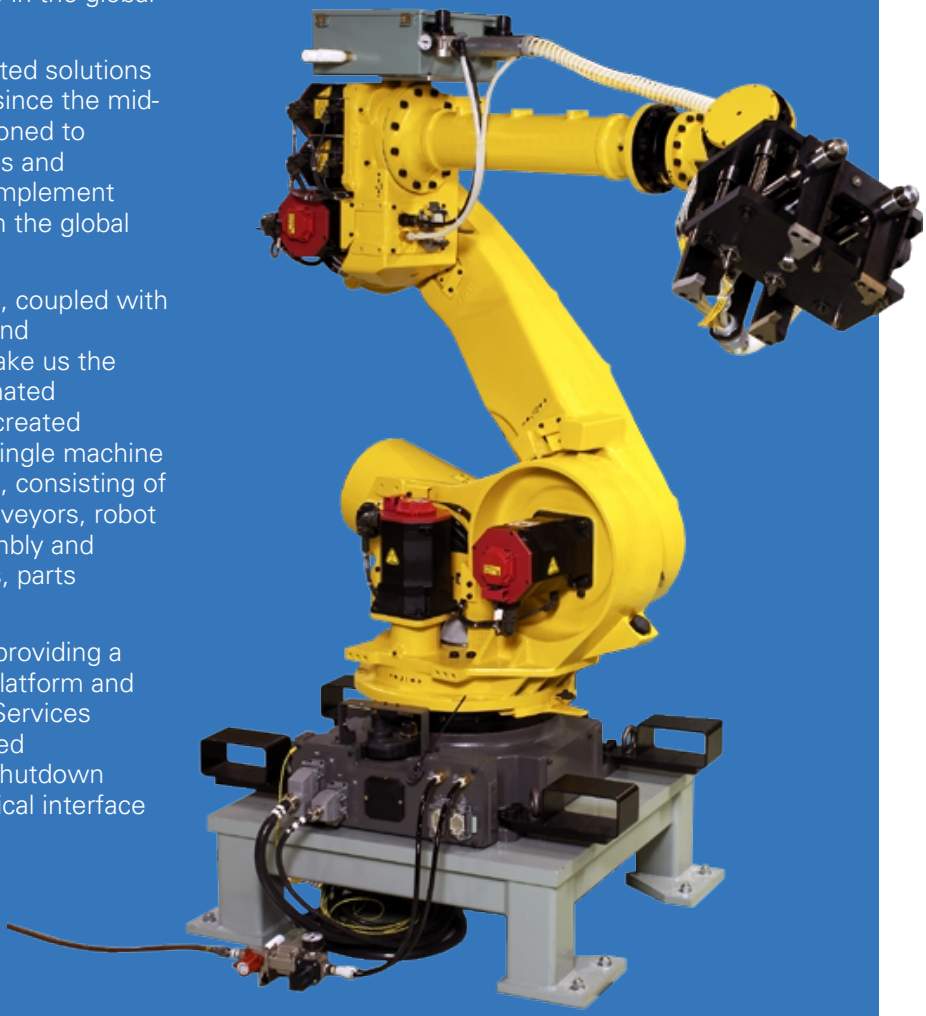
Makino has been developing automated solutions for manufacturers around the world since the mid-1990s. Today, no one is better positioned to provide you with the equipment, skills and manpower necessary to effectively implement automated solutions for competing in the global marketplace.

Our extensive integration experience, coupled with our production machining solutions and applications' engineering support, make us the only company you need for an automated production system solution. We've created everything from simple cells with a single machine and a robot loader—to large systems, consisting of Makino machining centers, parts conveyors, robot and gantry loaders, automated assembly and inspection equipment, parts washers, parts marking and more.

We coordinate all operator controls, providing a common human-machine interface platform and nomenclature. A Makino Integrated Services solution guarantees a tightly integrated manufacturing system with startup/shutdown procedures, alarm recovery, mechanical interface and part tracking.

While our solutions are automated, our service isn't. Our service teams include experts in every facet of automation integration. We customize our service to meet your unique and specific needs by providing a single source of dedicated project management and site coordination services, backed by the Makino staff of project, mechanical and controls engineers. A Makino automated system is a total system solution.

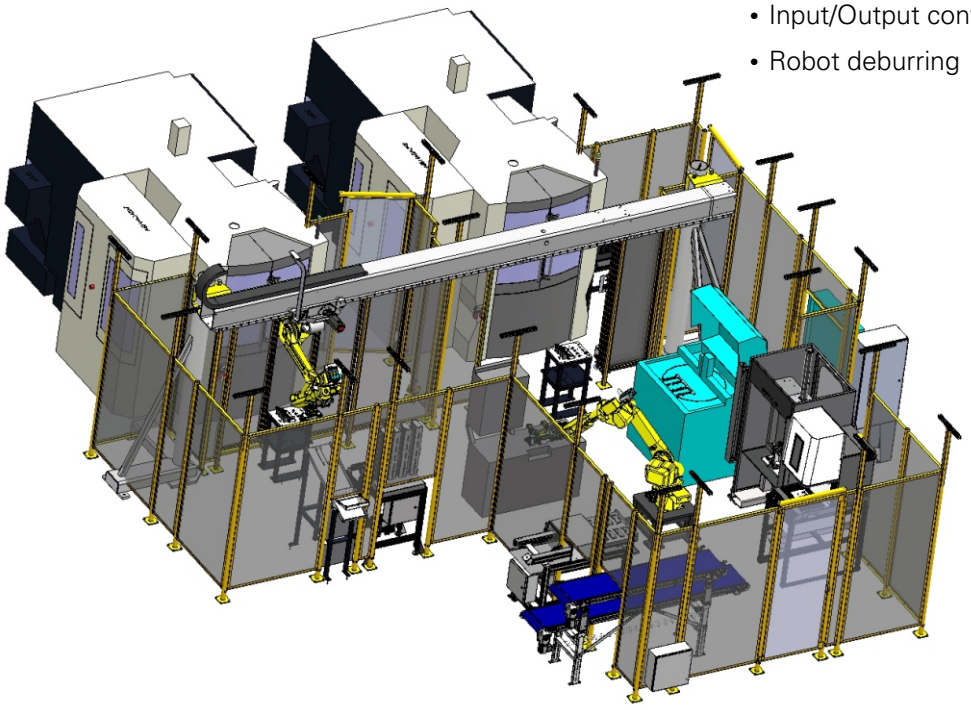
With Makino taking prime contractor responsibility, Integration Services frees up your time and resources that can be allocated elsewhere. Makino Integration Services ensures the smoothest possible installation of multi-vendor projects. As a single source, Makino provides fast resolution of your most challenging issues. As a company with extensive process and operational experience, we deliver the best solution—never compromising on quality or efficiency.



Automation Goals and Needs

One of the first benefits that comes to mind when considering automation is the possibility of reducing manual labor in order to lower cost per part. This is certainly one of the key benefits of implementing automation, but there are many more advantages that can help you meet your operational and business goals. Additional benefits include:

- Eliminate ergonomic issues: Some parts are heavy and can be difficult to handle. Even if the part is not heavy, many workplace injuries are the result of repetitive motions that can be avoided with automation.
- Free up operators: Instead of spending their time loading and unloading parts, automation makes it possible for them to attend to higher level work such as inspection and tool setting.
- Improved part quality: The consistency of how a part is loaded into a fixture can impact the quality of the parts manufactured. Automation can increase this consistency.
- Increased throughput: If the machine faults because of a misloaded part, time is lost as the operator corrects the mistake and reloads the part. Automation reduces the possibility of misloads that stop production.
- Increased OEE (Overall Equipment Effectiveness): The availability, performance, and quality can all be improved with automation, resulting in a higher OEE score.



Additional needs manufacturers are looking for when implementing an automation system include:

- Complete turnkey process with SPC runoff
- Integration of all material handling equipment (pedestal or gantry robotics, conveyance, input and output material handling, etc.)
- Integration of “pre” or “post” machining processes (part marking, leak testing, parts washer, minor assembly)
- Flexibility to redeploy for future production requirements

Automation Options

- There are many different components and combinations of automation elements that can be utilized to create the optimum system. Makino has the experience and knowledge to guide you through which ones are best for your needs. Some of the aspects of automation that Makino has successfully implemented over the years include:
- Pedestal robot
- Toploader robot
- Conveyor systems
- Vision systems
- Gripper indexing
- Gripper vacuum
- Inspections systems
- Part blow-off
- Part gage/reject stations
- Input/Output conveyors
- Robot deburring

Automation Essentials

For an automation system to be successful, there are several important features which are needed on the machine tools integrated into the system. First, flexibility is needed to control the fixture clamp/unclamp sequence and pressures through programming. This makes it possible for an automated load/unload operation to simulate an operator performing the task. Makino provides a Fixture Hydraulic Unit (FHU) that delivers continuous variable pressure with the ability to program clamp/unclamp sequences to dial in your part process. This feature enables you to program a part unclamp/clamp within the work zone to stress relieve a sensitive part between a rough and finish cut without stopping the process for manual intervention.

In the pallet stocker area of the machine tool, it is important to have auto doors to synchronize with the robot. The robot can be used to rotate the fixture to access multi-sided tombstone fixtures or the machine can be equipped with a power indexer that will automatically rotate the pallet stocker. Since an operator will not be standing at the machine and available to clear chips, chip accumulation can be managed automatically if the machine has an automatic stocker wash and through fixture wash. In addition, it is important to have the ability to run safely in manual or auto mode in case the robot is not available to load and unload parts.

It's also critical to have a seamless interface between the robot and the machine functions. If there is an issue that causes the process to stop in the middle of cutting parts, you want to have the ability to pick up where you left off through a part restart routine. This restart routine needs to understand the conditions of the machine and the automation to safely begin motion again without causing a wreck. Another key factor in managing the system is to have the ability to track the part status in the machine to determine if it is a raw or finished part. From a machine layout standpoint, access points should be designed to avoid interference with the automation. For example, the tool magazine door cannot be blocked by automation guarding.

Designing the workholding should take into consideration what is needed for smooth operation of the automation. To assist the robot load, part loading guides and part retention rollers can be employed. This will help direct the part into the fixture and prevent it from falling away from locating pads when the robot lets go of the part. Load verification through air part seat detect confirms the robot correctly loaded the part and prevents a quality defect or crash. Since an operator will not be at the load station to blow chips off locators, chip shedding features such as sloped surfaces and the elimination of chip-catching shelves can eliminate the buildup of chips. Another feature that eliminates chips hanging up on the fixture is internal hydraulic and coolant lines. Coolant nozzles directed to clean off rest pads also help with chip buildup. Also, to plan for the ability to manually load fixtures if needed, Poke-Yoke features should be designed into the fixtures to prevent operators from misloading parts.

Some of the process related essentials for implementing automation include:

- Broken tool sensing
- Pallet seat confirmation
- Tool life monitoring
- Tool length check macro
- Safe start blocks

Makino has developed a Cell Controller with a user-friendly HMI graphical interface to minimize the need for an operator or maintenance technician to handle the robot controller. This interface provides most of the key operational data needed to understand the condition and status of the machines and system. Some of the functions include:

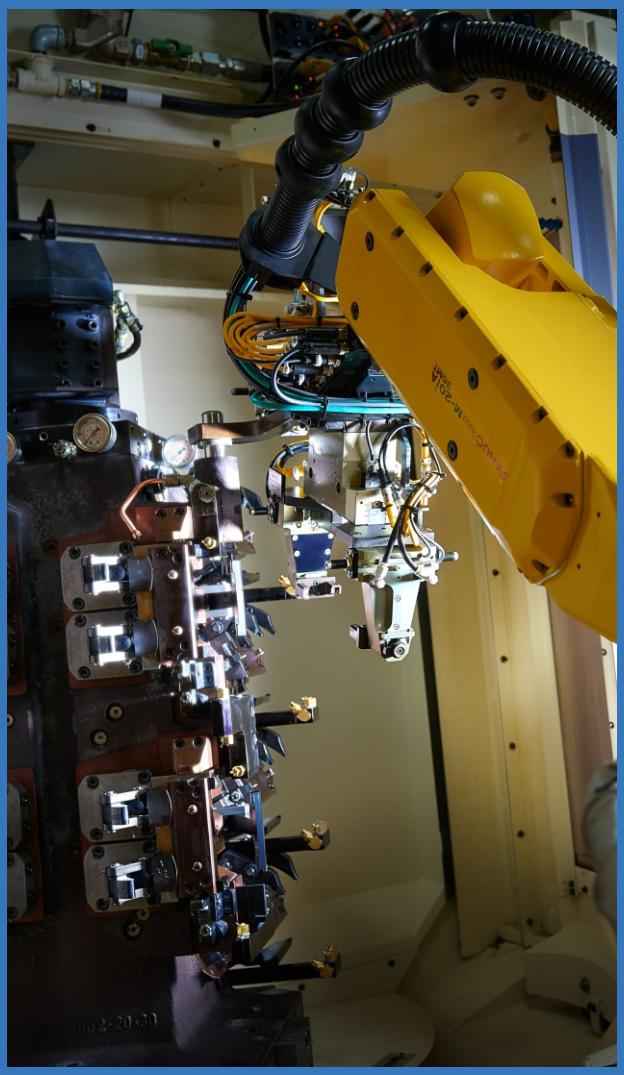
- Cell status overview
- Robot control
- Safety fence access control
- Gauge cycle counters
- Machine modes (Online, Runout, Offline)
- Multiple part number management
- Robot homing routines
- Material handling control

The smooth and seamless interface between the automation and the machines is what sets Makino automation apart from integrators that piece together discrete systems with handoffs. The robot interface designed by Makino provides a standard set of interface signals with these features:

- Robot and manual load modes
- Parameter selectable fixture control
- Part status tracking (Good/Reject/Gage)
- Part restart support
- Automatic Gage flag for first tool used
- Customizable robot interface/fixture control
- Part type selection
- Auxiliary equipment control (conveyors, parts markers, part blow-off stations)
- Robot work zone access control

What You Can Expect

Integration Services incorporates Makino machines into your manufacturing environment. The integration includes automated material load/unload, customizing machine operations, and third-party equipment. We provide full automation engineering services which includes cell controller programming, robot reach services, robot end-of-arm tooling (EOAT) gripper design, robot programming, conveyor designs, third-party technical management and human management interface (HMI) development. We've developed a cell controller that can perform a series of automated functions, including displaying an overview of the cell status, control robot start/stop and access to robot work area, gage cycle counters, cell runout, part type selection and part tracking.



Every Makino Integration Solution includes an array of services that encompass each step of the project, from start to finish and beyond. To make this happen, Makino has a team of professionals ready to work for you.

Project Management

With Makino Project Management, you have a single point of contact throughout the project, one person you can always rely on to answer your questions. Your designated project manager will oversee all third-party vendors, coordinate activities between all parties (Makino, vendors and you), track and report the project's schedule and take care of project changes.

Project Engineering

Project Engineering—which includes mechanical, controls and software—is equally comprehensive. It includes:

Specification/design reviews

Drawing approvals

Mechanical engineering (Robot EOAT design, layout design)

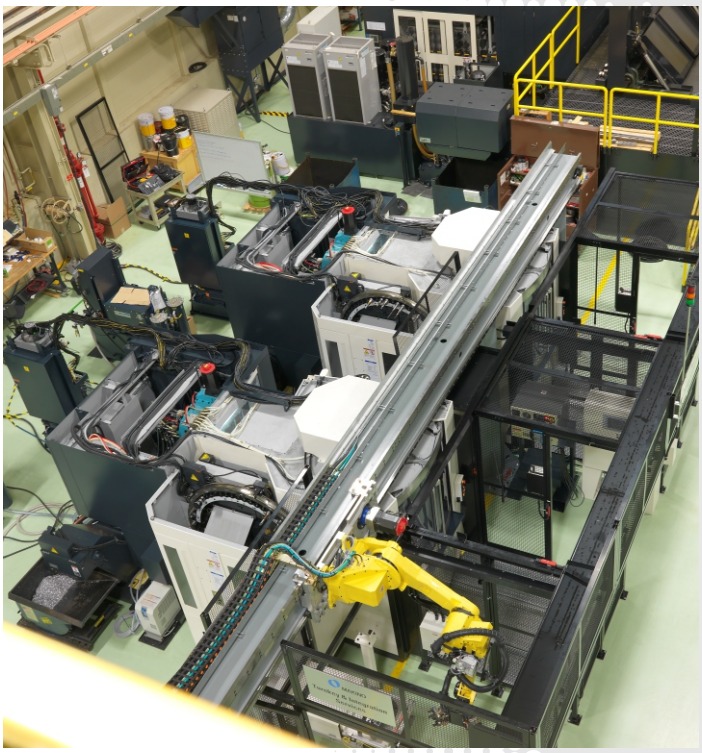
Control engineering (Design and programming)

Third-party equipment runoffs

System runoff support at Makino and at your site

Installation and startup support

Final documentation



Applications Engineering

Applications engineering develops the production-ready machine process, tooling, and fixtures. With these metal-cutting experts on the team, a fully qualified operation meeting your Cpk and cycle time requirements is assured.

Site Supervision

Site Supervision includes on-site coordination of all the project's installation activities.

Once again, you have a single point of communications and responsibility on site. You also have an experienced facilitator of manpower and scheduling.

Post-installation Support

A Makino Integration Services project continues long after installation. Our Post-installation Support not only helps make for a smooth transition into full production, but also provides an on-going resource for training and troubleshooting.

The Challenges of Integrating Automation

When integrating automation with machine tools and other auxiliary equipment without a single source provider, there are numerous challenges that are commonly faced such as:

- Multiple suppliers without a clear leader results in no one being accountable for your overall success
- Machining, part handling, and auxiliary equipment operating as an island without proper handshaking and communication across the system
- Takt time not balanced across the entire operation resulting in inefficient operations and a bottleneck
- Each supplier working toward their own schedule without coordination across all suppliers resulting in delays at the customer's expense

The Makino Difference

- When Makino is hired as your integrator, there is clear responsibility and accountability to make you successful.
- Makino provides single source solutions that avoid the finger pointing between suppliers
- Makino has extensive process and operational experience that touches all aspects of the automation and part processing
- Makino provides fast resolution of engineering issues since the knowledge and control is under one roof
- Makino delivers a smooth-running, complete system that results in lower manufacturing costs across the project life cycle

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