

Manufacturer Takes “Star Wars” Approach To Advanced Manufacturing Processes

Thousands of contract manufacturing shops across North America that produce commodity parts such as shafts, arbors, bearing races, gear splines, etc., have one problem in common, how to do it faster and less expensively. Precision Group Inc. (PGI) (Rockford, IL) believes they've found the solution.

Raymond Shaw, VP of Marketing for PGI said that the company takes an innovative (some call it “Star Wars”) approach to manufacturing commodity parts. They use advanced automation such as robots to reduce labor, and the most advanced machine tools available running 22 hours a day, seven days a week to gain productivity. Another vital element is PGI's Team Key approach to manufacturing which is the synergy of key stakeholders (equipment vendors, PGI, and the customer) into one cohesive unit with a great emphasis on trust and doing business with a handshake.

However these approaches also require a complete company culture change, new equipment, new ways to process work and fresh ideas from team members to productively produce customer's parts.

PGI was established in 1950 as the Illinois Machine Products Company. The business began as a captive machine shop to Woodward Governor Company. In 1977 the company became a supplier for a major off-road construction equipment manufacturer. Through the years, the company diversified in the aerospace industry with customers such as Bendix, McDonnell Douglas, Rockwell and Sundstrand. In February 1990, Precision Group, Inc. was formed through the combination of Illinois Machine Products Company and the acquiring of LaSalle Manufacturing & Machine Company. After years of gaining additional work from the off-road construction equipment manufacturer, the company grew to be in the upper five percentile for non-captive machining companies in the United States based on sales. PGI currently employs 194 people among three facilities, including a Deep Hole Drilling Division, totaling 153,000 sq. ft. Of the three facilities, the two contract machining plants are QS 9000 certified.

Birth of Team Key

PGI realized that to expand and produce world class products efficiently it needed to manufacture its commodity parts differently. To do this, the Team Key concept was

developed emphasizing a total culture change in the company. Now the company is product focused, responsibility and risk between team members are shared, and strengths and capabilities of the team members are built upon daily.

President and CEO David Morgan said, "today, engine and equipment manufacturers are looking to consolidate the number of suppliers with whom they conduct business. Our ability to design and build the necessary tooling, develop the prototype and take a part into high-volume production, has proved a real benefit." This is all part of the company's Team Key approach.

Now PGI looks at the entire process of part production to optimize it and the end product. They work with the drawings their customers provide, raw materials from suppliers, internal purchasing and scheduling, machine tools used for the work, tooling for the equipment, secondary operations such as grinding and deburring, and final JIT delivery to the customer.

For example, Plant Manager Les Anderson said that they'll often work closely with their customer to develop the end part so that production costs can be saved, whether it's redesigning the product, using a different part material or changing the suggested cutting process.

With the Team Key concept, in November 1997, PGI gained a large multi-year contract from their major customer to produce diesel engine shafts, a major project that initially began in November 1997. During the conception of this project, PGI realized their inability to handle the increase of the work associated with this project using their existing single-spindle CNC lathes. So began the journey for the most advanced machine tools to accomplish the goals set by the customer for this project.

PGI purchased three new Mazak Multiplex 630 twin-spindle/twin-turret multi-tasking turning centers with live tooling for milling, drilling and tapping. Integrated robot part handling using Mazak GL-200N Gantry Robot Loader/Unloader Systems are also used. They consolidated the machines in a 3500 sq. ft. area at the company's Falcon road complex for efficient workflow. Now in this area, raw parts are brought in and placed on special pallets. The pallets are loaded into the machines and the robot handling equipment moves the parts from the pallet to the spindle while delivering finished parts back to the pallet with the use of two separate grippers on opposite sides of the robot handler.

Next, the cut parts are deburred and then sent out for heat treating. From the heat treater they are returned and ground to final tolerances. Throughout the operations, parts are consistently checked for proper part dimensions.

PGI also has its own in-house Magnaflux capabilities. Some of their shaft work demands 100% inspection including checks for surface cracks.

Why Mazak

PGI's Team Key concept also extended to Mazak. MSI the Chicago, IL distributor for Mazak Corp. worked as a team with PGI and Mazak to select the proper equipment for their manufacturing and give them a production system. PGI wanted the most advanced machining technology available and the Multiplex 630 multi-tasking machines had the features and benefits they needed.

PGI researched four companies that had machine tools that could meet their initial needs. As a turn-key concept, the competing companies suggested the equipment and processes to produce the parts.

Anderson explained that Mazak's Multiplex 630 gave them all the features they were looking for in one machine. He said that a competitor might have twin spindles and live milling tools like the Multiplex, but they didn't offer high enough horsepower for the live tool to do heavy cuts. He also said that the Multiplexes were machines that truly offered all the capabilities of a vertical machining center and a lathe in one unit with the ruggedness and spindle power they needed.

With its twin spindles and twin turrets, it can machine both sides of a part with an automatic in-machine hand-off to the second spindle. With live tooling for tapping, drilling and milling it can complete a part without any secondary operations.

Anderson said that keeping their parts in one machine is extremely important. First there is no need to take the part from a turning operation to a secondary operation. So it actually eliminates the need for extra machine tools and their costs. It also eliminates the fixtures for these operations and the costs and time needed to build them. Because there is less handling and no fixture induced errors, scrap is drastically reduced and the expenses associated with the scrap. By keeping the machines running 22 hours a day, seven days a week, and using robot part handling equipment, spindle uptime is also optimized.

Andersen added that another way they compress manufacturing time and save costs with the Multiplex is in part changes. If a part modification or redesign has to be made, all it usually takes is a program change. There's no need to redesign and build new fixtures.

The 200,000 parts per year now manufactured on the Mazak Multiplexes were originally done on single spindle CNC lathes and mills. Production has increased by 30%

because of greater throughput. The five part numbers produced on the Mutliplexes fit in a 6" X 6" X 6" envelope. They are all made from either 4120 or 4118 steel.

Mazak's Multiplex 630 has a 12" chuck. Maximum cutting length for chuck work is 25.6". Main spindle motors produce 30 HP with speeds of up to 3000 RPM. A 10 HP rotary tool spindle motor on the turret can produce speeds up to 1500 RPM offering performance comparable to a machining center for secondary operations.

Each spindle has a 12-position drum turret, which indexes in 0.9 sec./one-step (2.2 sec./full step). Rapid traverse rate for the X-and Z axes is 945 IPM and for the C-axis is 100 RPM.

The Multiplex Robot Loader/Unloader System's gripping diameter for chuck workpieces is 1.97" to 11.81". For shaft workpieces it is 0.79" to 4.72". Each robot hand gripper can hold a part as heavy as 22 lbs. (total weight for two grippers combined is 44 lbs.).

Mazak's new Mazatrol Fusion 640 CNC is used on each Multiplex 630. The term "Fusion" describes the seamless connection of a very fast, 64-bit RISC processor for CNC control with all the front-end capabilities of a PC. It offers accelerated computing speeds for spindle and axis controllers, faster more efficient look-ahead machining capabilities, smooth high-gain servo control and tool path optimization.

The user interface is the Windows 95® operating system, giving Mazatrol Fusion 640 bi-directional communication capabilities between its fused PC and CNC and other factory PCs.

Its PC control can deliver daily and weekly status reports for spindle load, spindle speeds, part counts, and machine status on a real time basis. This information can also be accessed from a remote office.

Anderson said that the Mazatrol Fusion 640 CNC capabilities are tremendous and they hope to take full use of it in the future. "I want to be able to control these systems from home. And if a special part is needed while I'm not at work, I'll communicate with the machine and have it automatically run the part without operator involvement." Currently they download part programs through PGI's intranet network to each machine.

New Ideas

Through PGI's Team Key concept unusual ideas are born. One was the material handling pallet system used on the Multiplexes. To save costs, a unique ABS thermoformed pallet system was developed that could nest six different parts both cut and uncut. It had to be designed to

handle part positioning tolerances of +/- .030" for the robot gripper. Pallets like this could cost thousands of dollars. But the idea was born and produced for just \$65 per thermo formed pallet. Gripper jaws for the two robot heads were also produced in-house.

In the long term, the Team Key approach has built trust between their largest customer and PGI. PGI will continue to expand its use of automation and high technology manufacturing equipment. They plan to become a tier one supplier for OEM diesel engines and driveline systems. In the near future, they will add two more Mazak Multiplex's and continue to redesign their plants for optimization of material and part flows.