FANUC

NEW LIFE FOR OLD IRON

Microtrol Engineering and Triumph Aerospace

Over the course of 30 or 40 years, it is easy to adapt to some of the unique characteristics and behaviors of industrial equipment. After several decades of heavy use the Cincinnati skin mills at Triumph Aerospace in Hawthorne, CA developed a long list of unique operating characteristics. The operators developed various ways to make the machine compensate for many of these characteristics, but eventually the company realized it was time to look for a different solution. These machines mill and form the skins for Boeing 747 and 767 aircraft. This facility has four skin mills – three Cincinnati profilers (5-axis/3-spindle), and one SNK PM11A dual-head skin mill.

Triumph started looking for a new solution and started to weigh the options of new machines versus retrofitting their existing ones. While the thought of gleaming new machines with all the new features is tempting, it does come at a cost. Triumph received bids to replace their machines that were in the $2-3 million range, per machine for the smaller mills and $5-7 million for the larger SNK mill. Each machine also had a 3-4 year lead time.

Triumph reached out to Brandt Fine of Microtrol Engineering, Torrance, CA to find out about retrofitting options. Microtrol is a FANUC Authorized CNC System Integrator and has managed hundreds of retrofit projects, specializing in large 5-axis machines. Microtrol's solution addressed all Triumph's concerns and would only take 5-8 weeks per machine. There was also a great cost advantage with the retrofits only costing about 10% of the price of a new machine.

Microtrol's solution retained the existing machine, all the old iron, while stripping out and replacing all of the electrical equipment and components. The three Cincinnati Profiler machines are 5-axis simultaneous, 6 total axis machines. They are outfitted with FANUC 31*i*-MODEL B5 controls, which provide accurate, high-speed machining. The dual-head skin mill required up to 9-axis simultaneous machining, so it had a FANUC 30*i*-MODEL B installed.

GROWING LIST OF CHALLENGES

These machines were installed in the 1970s and 1980s and were still operating with their original Cincinnati Milacron 'Big Blue' controls. Obsolete parts and support challenges were an ongoing concern as the supply of spare parts was getting tighter. There was always a worry that one component failure could bring their machines, and their business to a halt if they could not find a spare. One of the primary reasons that Microtrol leads with FANUC is their lifetime support for their products. As long as the equipment is in use, FANUC will support it with replacement parts or engineer a replacement solution to keep it in operation, eliminating the worry of obsolete parts or out of service equipment.

POWERING THROUGH THE BROWNOUTS

This area of Southern California is very susceptible to power dips and brownouts. When machine tools are running programs with tight tolerances, even a slight variation in the power supply can have an effect on the finished part. In Triumph's case they are running with about a 5/1000 of an inch tolerance. With the old controls, when a power bump occurred the machines would simply shut off and the milling head would drop into the part. If it dropped more than 5/1000 of an inch, the entire part may have to be scrapped. This would happen about once a month, and could cost $20,000 or more each time depending where in the process the scrapped part was.

> "FANUC has a record of being able to support controls that are 20, 30, 40 years old, so they can still get you parts. So with these machines, even 20 years down the line, I will still be able to get repair parts for them."

Microtrol overcame this problem by using the FANUC Power Failure Back Up feature. With Power Failure Back Up, if there is a power bump or brown out, the control will divert power generated by the spindle motor and divert that to pulling the machining head off of the workpiece. With this feature the power from the spindle can actually power the system long enough to work right through minor power fluctuations.

Since the new system was installed with this feature the power bumps and brownouts continue, but there has only been one significant enough for the machine to shut down. Not a single workpiece has been scrapped due to a power bump.

TIME TO RESET

Losing a workpiece worth over $20,000 due to a power bump is bad enough. But when it takes over four hours to reset and recalibrate the machine, it can be devastating to your production schedule. That is what Triumph was facing when they had to reset the machine after a power bump.

With the Power Failure Back Up system, they system will typically run through any minor power bumps, but if there is a cause for it to shut down, all the operator needs to do is restart the control and continue

PROGRAMMING TO THE POINT

Tool Center Point Control (TCP) is a standard 5-axis programming feature on the FANUC 31*i*-B control that simplified the way parts were programmed on these machines. With the old system the cutting point would be programmed from the knuckle of the spindle, which was about 12 inches above the cutting surface. So the part program would have cutting depths of 12 inches or 16 inches, when in reality the cutting depth might only be a few hundred thousandths of an inch. When programming like this the length of the tool needs to be perfectly set. If the length is off, even slightly, it can multiply as the angle of the cut changes.

TCP programs are written based on the tip of the cutting tool and the control compensates all of the additional information. The operator has to enter the length of the cutting tool and the system will calculate and adjust accordingly to maintain the same tool center point on the part.

OVERCOMING THE DROOP

The SNK PM11A is a very large machine, and its size and scale creates a unique set of challenges. The milling heads on this machine weighs several thousand pounds. As they travel across the Y-axis bridge, they were causing a droop towards the center of the bridge. The droop was significant enough that if it was not adjusted for, the parts that were cut would be out of spec. The old system used Shadow Mapping to adjust for this, but it was cumbersome to use, had to be reprogrammed for each part program and reset each time there was a power bump.

> "Before the retrofit, they were scrapping about 12 parts per year. Since the new FANUC controls went in with Power Failure Back Up, they haven't lost a single part."

Microtrol used the FANUC Straightness Compensation function to compensate for the droop created by the weight of the milling heads. While measuring the droop caused by each of the two milling heads, it was discovered that each milling head was causing a different droop. In addition, when the two milling heads were positioned towards the center of the bridge, the system had to compensate for both of the milling heads depending where on the bridge they were. All of this was handled by the FANUC Straightness Comp system and laser calibrated to ensure accuracy. With the new system in place, they no longer need to worry about the droop affecting their parts. The Straightness Comp system adjusts the position of the cutting tool based on the position of each head and provides an accurate depth of cut without having to be reset or reprogrammed.

END RESULTS

During the decision making and implementation phase there was a lot of concern that the new system would not deliver as promised. These were people that grew their careers alongside that machine and were wary of change. They simply did not believe the new system could eliminate all of the issues they experience on a daily basis.

Once the system was in operation, their opinions quickly changed. First of all, it seemed like the machines were no longer affected by rolling blackouts. While other equipment in the shop would go out, the equipment with FANUC controls never seemed to shut off. They just keep going. The biggest impact is that in the three years since the retrofit they have not had to scrap a single workpiece due to power bumps.

Another benefit is access to operational information. Machine operators like the fact that they can view and access all of the operating data. All they had access to with the old system was the four positioning coordinates. Now they could see all the positions, program data and operating data. Overall production rates saw dramatic improvements. Prior to the retrofits, machining a skin would take between 12-20 hours to process. With the new controls, motors and drives, this processing time has been reduced by about 50%.

In the end all of the problems they thought were going to happen, didn't, and all of the existing problems were eliminated. The FANUC controlled machines are now the favorite machines in the facility.

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