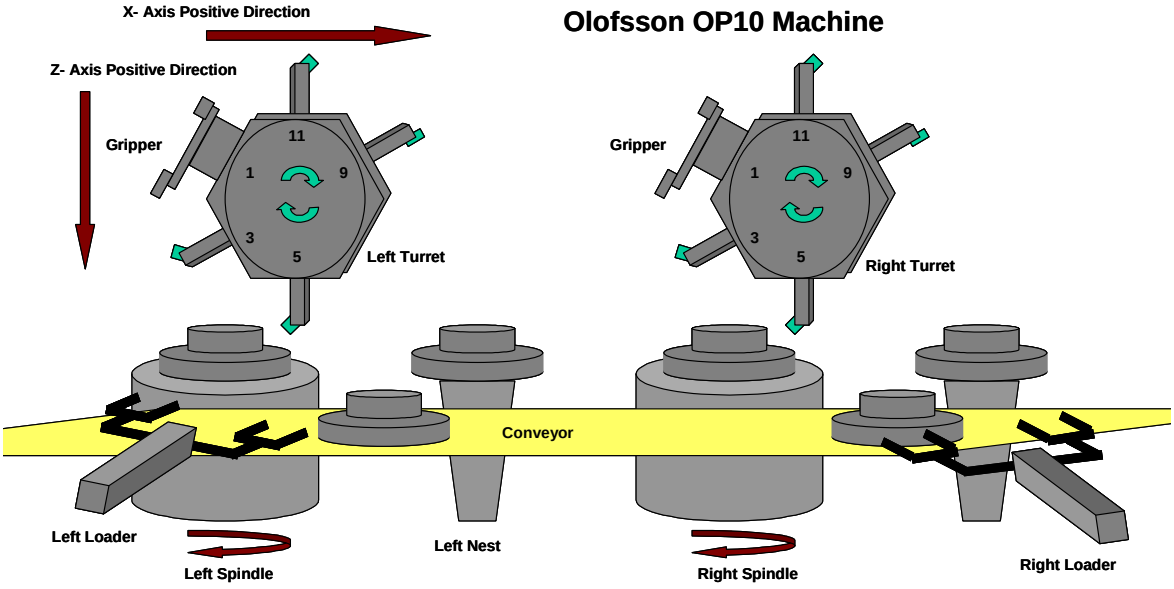
Automotive Parts Grinder

Converting an AB CNC/PLC control system to a Modicon Momentum-based control system

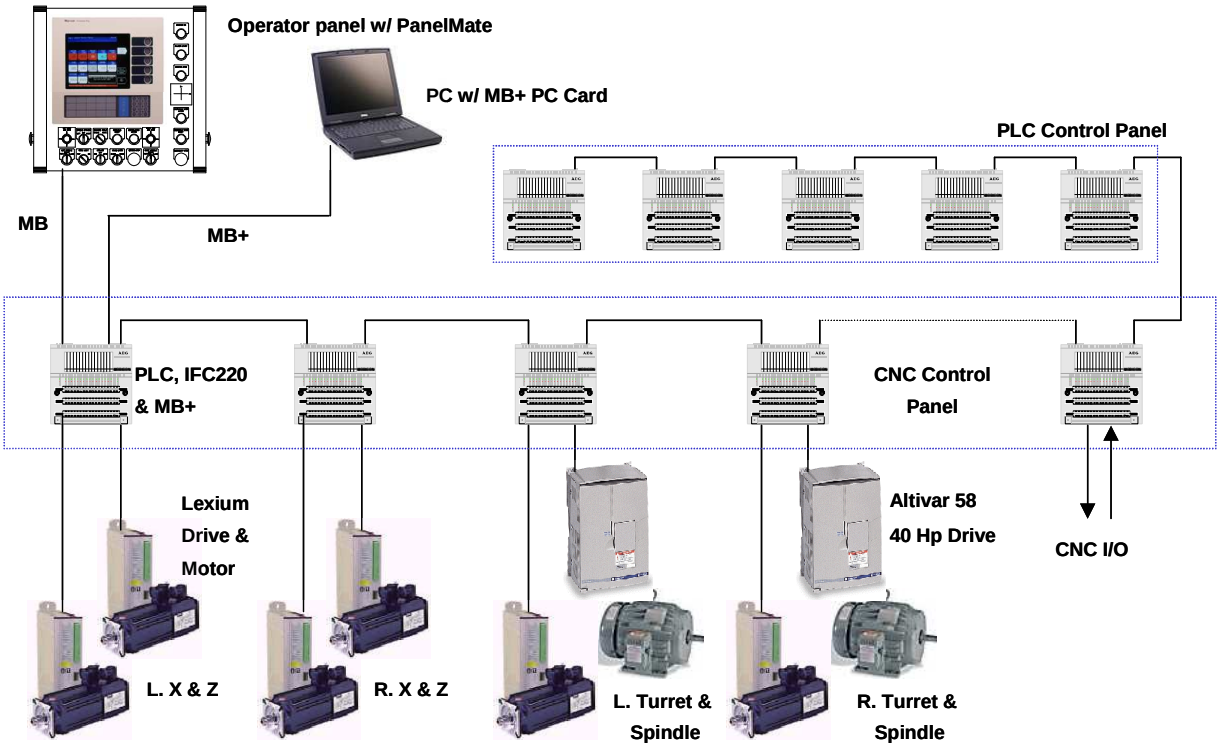


Introduction

GM Powertrain had 8 six-axis, two spindle Olofsson Flexturn vertical turning machines that were in need of control upgrades due to the obsolescence of the existing control hardware. These machines are divided up to perform two different machining operations on a transmission part. The machines are automatically fed by a series of conveyors and two loader/unloaders per machine. The old control system consisted of two AB 8200 CNCs, an AB PLC/2, numerous 1770 I/O modules, a single CNC monitor, six GE Hi-Ak DC servo amplifiers, and two DC spindle drives. The machine was divided into a left and right side with each AB CNC controlling an X, Z, turret, and spindle. The AB CNC communicated to the AB PLC/2 via CNC I/O and the PLC/2 1770 I/O. All machine interlocks, conveyor, and loader/unloader I/O were controlled by the AB PLC/2. The only data entry for offsets and machine setup was done through a single 9-inch CRT that had to be switched between the two CNCs. The existing machine had no means of connecting to the existing plant network. The existing DC servo drives and motors also were in need of replacement to increase the uptime on the machines.

Phase I Control System Upgrade

The control upgrade was done in two phases. First the existing AB 8200 CNCs and AB PLC/2 were replaced with four Integrated Industrial Technologies, Inc. (I²T) IFC220E-MPL Momentum 2-axis motion controllers, a Schneider Electric (=S=) Momentum PLC with I/O bus, a Modbus Plus(MB+)/ RTC option adapter along with various Momentum discrete I/O modules. The MB+ port on the option adapter allows future connectivity of the machines to the plant information network. The new I/O count was reduced by using the I/O bus and virtual I/O to the I²T IFC220E-MPL modules. A single PanelMate operator interface was connected to the PLC Modbus port for soft pushbutton replacement, data entry/setup, and machine diagnostics. A custom operator pendant housed the PanelMate, joysticks, and commonly used pushbuttons. The IFC220E-MPL interfaced to the existing servo motors and spindles via the ±10vdc analog outputs, Sony linear scales reported the position of the X and Z axes back to the IFC220E-MPL to allow position accuracy down to 0.0001 inches. Drop-in panels with the IFC220E-MPL and Momentum I/O prewired to terminal blocks, allowed fast commissioning of each machine over a weekend.



The AB 8200 CNC block code was converted to I²T MPL programs that reside in the IFC220E-MPL. The MPL code is an English like language that allows users to easily develop and read complex motion sequences that would otherwise complicate the PLC programs. Positions, feedrates, offsets, and virtual I/O were exchanged between the MPL programs and the PLC via user defined registers across the I/O bus adapter network. Point-to-point, linear, and circular profiles coordinate the X and Z-axes to perform the complex CNC-like motion. Data and virtual I/O was exchanged between the IFC220E-MPL modules, via the PLC, to control the speed of the spindle for constant surface speed cuts. All axis positions, status, and diagnostics were reported to the PLC via one loadable function block per IFC220E-MPL module. Program control, manual

feedrate-override, virtual I/O, and register data are handled by the same loadable function block in the PLC. Since the module converts encoder counts to user units, all values in the PanelMate, the PLC, and the MPL language are displayed in user units. By having the complex motion sequences stored in the IFC220E-MPL, the PLC logic consisted of only interlocks and step sequencers to control all of the machine functions. Since the new control system was simpler and easy to understand, GM personnel were able to modify their existing process to allow for a 15-20% decrease in cycle time, also allowing for an increase in tool life. Factoring this across the other machines increased productivity significantly for these operations.

GM Powertrain originally specified a GE FANUC CNC, an AB CNC, or a PC based CNC from MDSI for this application. By using =S= and I²T products a simple cost effective PLC based solution that is easy to maintain by GM personnel was achieved.

Phase 2 Servo and Spindle Upgrade

Phase 2 of the control upgrade required the replacement of the old dc servo motors/drives and the spindle motors/drives. The six GE Hi-Ak servo amplifiers and motors were replaced with =S= Lexium servo amplifiers and motors. A =S= Altivar 58 40hp vector drive and AC vector motor replaced the existing 25hp DC drive and motor. By upgrading to the latest brushless technology GMPT realized more uptime on each of the machines. Also the newer motors and drives have more torque and speed capability than the older drives and motors, allowing for an increase in federates, resulting in 10% lower cycle times. The increase in feedrates depends on the cutting speed of the inserts being used, but in all cases, the surface finish of the parts was better.

Benefits to the Customer

The following benefits were realized by the customer for selecting the I²T / =S= control and servo system solution:

- Simpler, and easier to use than the existing or competitive solutions
- Improved diagnostics and status over existing system
- Increased understanding of existing process
- Fast commissioning of new control system
- Inexpensive compared to competitive solutions
- Increase in productivity (decreased cycle time, more uptime)
- Better surface quality on machined parts
- Decrease in control, drive, and motor maintenance (increased uptime)
- More diagnostic and status information available to maintenance and operators
- Connectivity to the plant network