Application Story: Siemens Motion Conotrol Information System (MCIS)

TOTAL MOTION CONTROL AT AUTO ENGINE PLANT

The task of building a 3.9L V-6 engine at a major U.S. carmaker is being made easier as a result of a total Siemens Solution for Powertrain, based upon the Siemens TRANSLINE System Solution and Motion Control Information System (MCIS). This system solution is enabling the production of cylinder-deactivation system engines at one of the largest engine plants in the world. Nearly 500 SINUMERIK 840D CNCs and SIMATIC S7-300 PLCs on the machine tools, transfer lines, robotic buffers, sub-assembly and other equipment are controlled by this total Siemens powertrain motion control system.

As this plant was being planned in 2003, to become the carmaker's premier agile manufacturing facility, an assessment was made of the various machining and materials handling requirements. As groups of data would be collected, then fed to central connection points, then to the FIS (Factory Information System), it was essential to seek out a powerful machine control that could handle these tasks. Likewise, the control needed to be accessible to various operators, working with a variety of machine tool builders' equipment and other devices

Following a thorough review of the cutting parameters, as well as the transfer line set-ups, it was determined that approximately 400 machine tools were needed to accomplish the various operations. Central to the process were ten work cells, each containing six EX-CELL-O machining systems and four COMAU machining systems with Dürr material handling, as well as robotic buffers and other builders' equipment. The machining systems would have independent CNCs onboard, which would transmit data to intermediate cell controllers. These cell controllers would then feed production data to the host server.

The cell controller is essentially a PC, which can monitor up to 80 machines, according to the supplier, Siemens Energy & Automation, who also supplies the predominant individual machine tool CNC chosen for this engine plant, the SINUMERIK 840D. Typically, the status of all machine tool operations, as well as alarm signals, is channeled to an Oracle database, as part of the cell controller to the FIS. The data are utilized for the company's production monitoring and control system, which seeks to compile all parametric functions of machine operations plant wide, for subsequent analysis and process improvement. The Siemens SINUMERIK 840D is an Ethernet-capable CNC, used worldwide in existing automotive manufacturing networks at nearly all OEMs, to create an economical interface to Windows PC or UNIX workstations. With the integral NC program management DNC, networking of all CNC machine tools and other devices is made possible throughout the OEM's manufacturing architecture. Programming can be done directly to the machine control, as a result.

Alarm functions, which signal any off-normal condition in machining, tool orientation, material feed, handling mechanisms or transfer failure are processed by the cell controller and sent to ANDON display boards, which hang suspended over the work cells to alert plant personnel to the condition. Instantly, the service personnel can address any issue.

According to the carmaker's process engineers, the original concept for the cell controller was developed by a senior project engineer in powertrain manufacturing. By accessing all information from the machining cells and transfer lines through the cell controller, company personnel would have a faster and more centralized data station on the factory

Above Left: EX-CELL-O systems, used inline for cylinder machining operations, feed data through the Siemens network to the host server

Above Right: The Siemens SINUMERIK 840D Ethernet-capable CNC is utilized on nearly 500 machine tools, transfer lines, robots and auxiliary equipment at this engine plant; used in concert with SIMATIC PLCs for total motion control

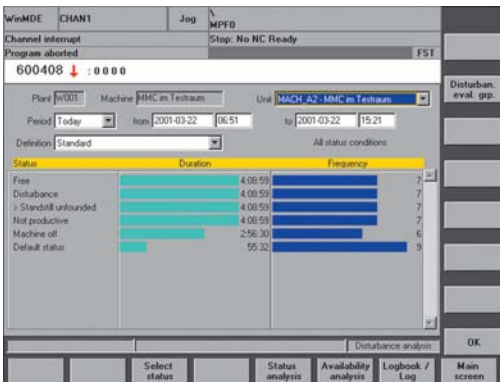
floor. In addition, a practical advantage derived from the cell controller's ability to activate full line start/stop commands.

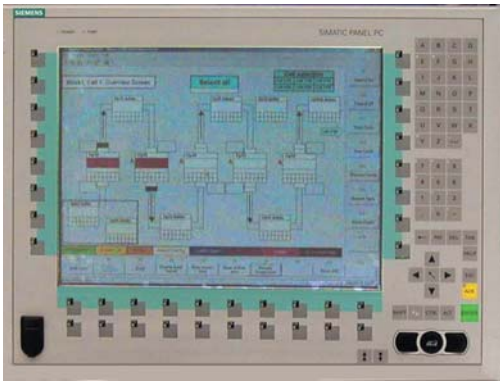
Each cell controller is a standalone unit and enables operations personnel to check historical alarm logging and fault conditions for localized cell management. This function is in addition to the overall processing of alarms and status readings to the host FIS database.

Thus, a particular station operator can inform control personnel of a recurrent alarm or off-normal condition, more quickly.

This entire MCIS (Motion Control Information System) was developed and implemented by Siemens, working with customer powertrain engineers, as well as EX-CELL-O and Comau personnel. On the HMI (Human Machine Interface) devices, as well as overall cell controllers and individual machine CNCs, Siemens' Solution for Powertrain—TRANSLINE, is utilized. TRANSLINE provides commonality to all operator displays and machine control architecture. Thus, whether an operator is setting up or checking status on a transfer machine, machining center, robotic automation, parts washer, or even an intermediate cell controller, the hardware onboard each machine has a similarity of feel and touch. This makes training and service goals more easily achievable. Furthermore, owing to the open architecture on the controls, software compatibility issues are more easily addressed and the TRANSLINE System Solution facilitates smoother transition between different machine types, according to customer personnel interviewed.

Tool functionality and comparative productivity between the work cells are being achieved with Siemens MCIS, as well. Tool and maintenance data, plus machine vs. machine and cell vs. cell comparisons allow control personnel quick access to conditions in-process. This is particularly advantageous at this customer's facility, which remains one of the largest





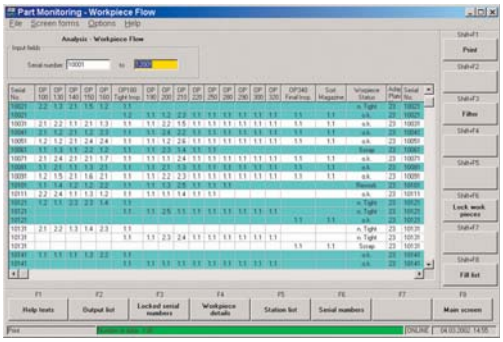
engine building complexes in the world. One production line has been running since late 2004 and a second is now fully operational. Produced at this facility are various cylinder-deactivation system engines, which achieve greater fuel economy, especially in highway driving conditions.

Through close collaboration on the software development between Siemens and customer personnel, it was not necessary for any portion of the host FIS to be modified or codes rewritten to implement this MCIS at the facility. As one senior project engineer describes the system, there are two main components to the manufacturing process, namely, a cylinder head and cylinder block section. In each section, a number of machine cells and robotic buffer lines operate. These lines are currently functioning in both head and block sections. The automation buffering, tool management and all machining functions are monitored throughout each section. Typically, in a block line cell, 15 CNCs are monitoring each wing base, with the main cell controller nearby on the factory floor. All the cell equipment is activated by a main master operator control, enabling faster start-up and shutdown of the section cells from each intermediate cell controller.

All section data are fed on the standard Siemens SIMATIC S7 Ethernet protocol to the cell controller and then with the OPC protocol to the FIS system for production management/control compilation and ANDON board displays. This additional portion of the data communications system is part of the Siemens response to the growing demand for enhanced network topology in automotive powertrain and other manufacturing sectors, according to company sources. Here, this "common thread" approach is an essential component in the overall establishment and maintenance of their resident production management scenario.

Left and Above: Cell controller used for monitoring and control of all machines within the cell

Left: MCIS MDA from Siemens tracks machine time utilization



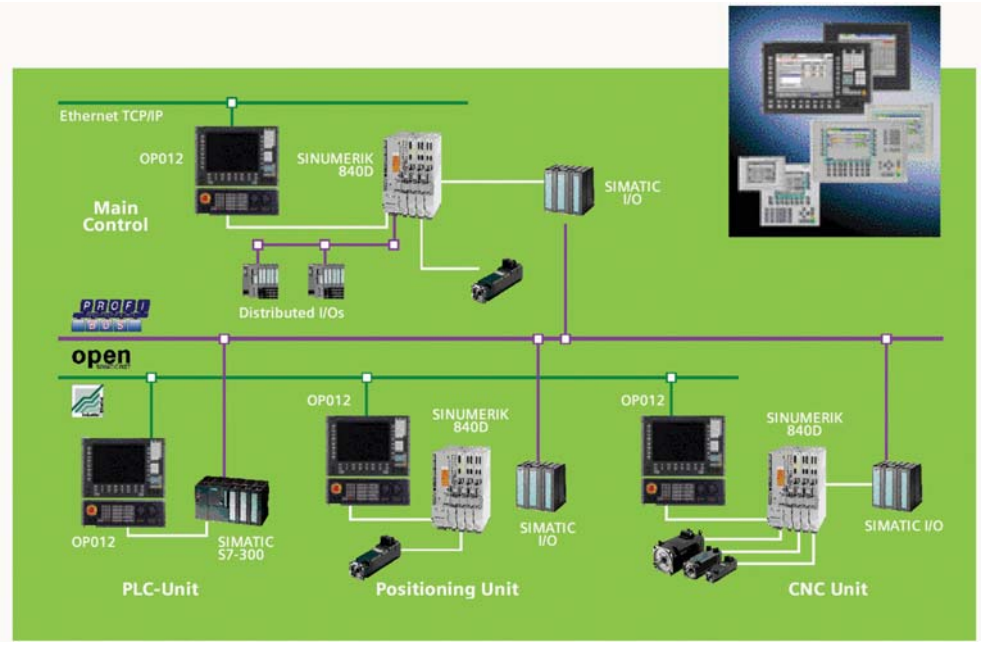
Left: MCIS PMT tracks part maintaining and tracking, assembly and production functions to aid quality analysis

Right: MCIS TDI is a tool management system for individual machines, transfer lines or entire plants, with all data accessible for improving overall tool management

Detail diagnostics on the PC at the cell controller determine the start/don't start command and memory mapping enables the control personnel to maintain full and immediate access to all stored data.

All production and test operations, including drill, tap, mill, bore finish, washing, thread test, leak test and block/head alignment are also monitored.

The primary builders, EX-CELL-O in Germany and Comau Pico in Italy, worked closely with the customer and Siemens teams, as the agile manufacturing goal requires independent, modular functions which are nonetheless linked on a common highway for data management and control. This challenge was met by the use of Siemens SINUMERIK 840D CNCs, the TRANSLINE System Solution and MCIS. ■



Left: TRANSLINE provides a common control structure on various machine types, enabling enhanced cross-training, greater operator uptime and quicker access to production data in real time

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