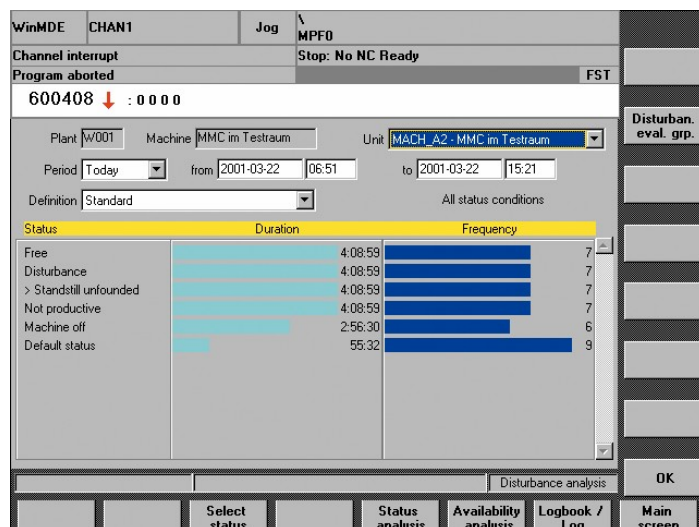


Monitor machine tool cells with a centralized PC-based SCADA system

An engine plant installed PC-based cell controllers to monitor CNC machine tool operations and alarms, and bring information into production monitoring, control and annunciation systems.

Alarms are processed and sent to display boards for immediate attention by service personnel, and equipment functions are monitored plant-wide for analysis and process improvements.

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 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, subassembly 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 factory information system (FIS), 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 are 10 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 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 used by 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. As a result, programming can be done directly to the machine control.

Serial No.	DP 100	DP 130	DP 140	DP 150	DP 160	DP180 Tight Insp.	DP 190	DP 200	DP 210	DP 220	DP 250	DP 260	DP 280	DP 290	DP 300	DP340 Final Insp.	Stat. Magazine	Workpiece Status	Adm. Plan No.	Serial No.
10021	2.2	1.3	2.1	1.5	1.2	1.1												n. Tight	23	10021
10021						1.2	1.1	1.2	2.3	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	ok	23	10021
10021	2.1	2.2	1.1	2.1	1.3	1.1	1.1	2.2	1.5	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	ok	23	10021
10041	2.1	1.2	2.1	1.2	2.3	1.1	1.1	2.4	2.2	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	ok	23	10041
10051	1.2	1.2	2.1	2.4	2.4	1.1	1.1	1.2	2.6	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	ok	23	10051
10061	1.1	1.3	1.1	2.2	1.2	1.1	1.1	2.3	1.4	1.1	1.1							Scrap	23	10061
10071	2.1	2.4	2.1	2.1	1.7	1.1	1.1	1.1	2.4	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	ok	23	10071
10091	1.1	2.1	1.1	1.3	2.1	1.1	1.1	2.1	1.3	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	ok	23	10091
10091	1.2	1.5	2.1	1.6	2.1	1.1	1.1	2.2	2.3	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	ok	23	10091
10101	1.1	1.4	1.2	1.2	2.2	1.1	1.1	1.3	2.5	1.1	1.1							Rework	23	10101
10111	2.2	2.4	1.1	1.3	1.2	1.1	1.1	1.1	1.4	1.1	1.1							ok	23	10111
10121	1.2	1.1	2.3	2.3	1.4	1.1												n. Tight	23	10121
10121						1.1	1.1	2.5	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	ok	23	10121
10131	2.1	2.2	1.3	1.4	2.3	1.1												n. Tight	23	10131
10131						1.1	1.1	2.3	2.4	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	ok	23	10131
10131																		Scrap	23	10131
10141	1.1	1.1	1.1	1.2	2.2	1.1												ok	23	10141
10141						1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	ok	23	10141

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 floor. In addition, a practical advantage is 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.

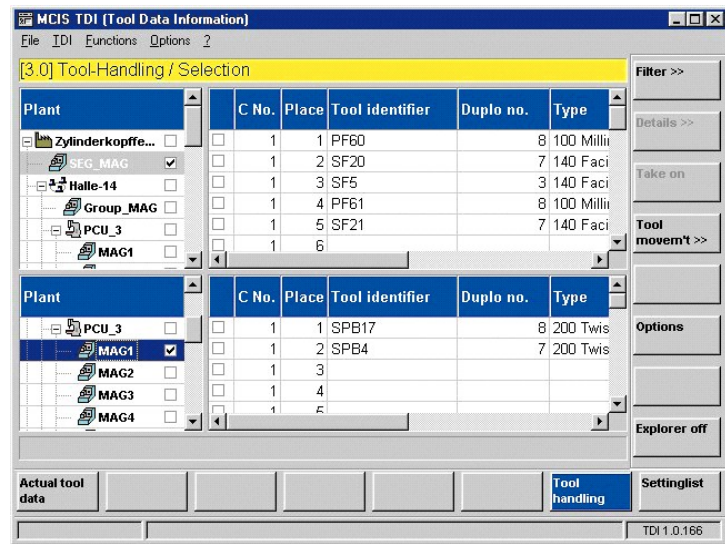
Thus, a particular station operator can more quickly inform control personnel of a recurrent alarm or off-normal condition.

The entire motion control information system (MCIS) was developed and implemented by Siemens, working with customer powertrain engineers as well as EX-CELL-O and Comau personnel.

The human-machine interface (HMI) devices, as well as overall cell controllers and individual machine CNCs use Siemens' Solution for Powertrain-TRANSLINE system. 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 achieved. 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 work cell productivity comparisons are also being achieved with Siemens MCIS. 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.

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.