The "Paperless" Factory

The next step in efficient gear manufacturing.

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You're already a veteran of the computer revolution. Only you and your controller know how much money you've spent and only your spouse knows how many sleepless nights you've had in the last ten years trying to carve out a place in the brave new world of computerized gear manufacturing. PCs, CNCs, CAD, CAM, DNC, SPC, CMM: You've got a whole bowl of alphabet soup out there on the shop floor. Overall these machines have lived up to their promises. Production time is down, quality is up. You have fewer scrapped parts and better, more efficient machine usage.

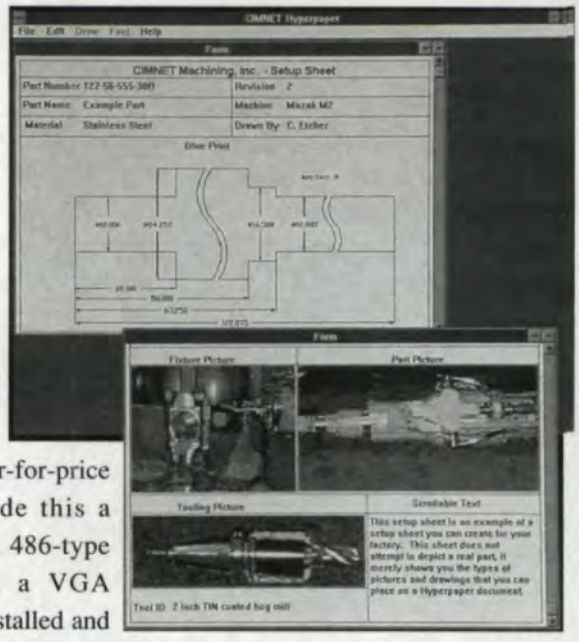
Still, there are glitches in the system—places where things come to a halt while someone brings the paperwork from the other side of the factory, looks for a lost blueprint or waits for a work order. And still your customers demand higher quality in less time and, ever and always, lower costs. So what's the next step?

Many say it will be the "paperless" factory—a production environment where information and data are transferred electronically over networked computers. Instead of having an operator walking around getting a blueprint or fixture, he or she stays at the machine, retrieving instructions on a workstation. At the very least, having the right information where it is needed, when it is needed, will increase machine usage significantly and eliminate errors.

Sounds good, but how feasible is it? Can you actually get to the point of "paperless" manufacturing, and if so, how?

The answer is "yes, you can," and the way you get there is step by step.

Converting to a paperless manufacturing operation is a gradual process. The basic premise to understand and accept is that eventually each operator stationed at a machine or machine cell will have a computer connected to a network. The astounding improvement in computing-power-for-price of PCs has made this a realistic goal. A 486-type computer with a VGA color monitor, installed and connected, can cost as little as $1000.



The machine operator's interface is critical to fast, effective implementation of a paperless factory. CIMNET™ Folders' WorkMan module has a button for each of the operator's primary tasks.

In the ultimate paperless office, these computers are connected to each other by a MICS, a Manufacturing Information Control System. Once this network is in place, all paper documentation is put in digital form. Hand-written pages, such as fixture drawings, are scanned into the computers with a simple inexpensive scanner. Word processors, spreadsheets, databases and planning programs all generate files that are stored on hard drives, if not on an existing network. All the data is available by means of a few keystrokes to anyone who needs it. Fundamentally, that's all there is to the "paperless" factory. Realistically, there are lots of details to work out.

The Machine/Operator Interface

The first detail is winning over your machine operators. They are usually reluctant to use computers for many reasons. Expecting them to readily change and adapt to this new

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way of working without special consideration is unreasonable. The key to making the paperless factory work is to make it easy for the machine operators to learn and use the computers.

Machine operators are used to computers that, for the most part, require the push of a few clearly labeled buttons. Having a lot of options, as is common in the newer graphic user interfaces (GUIs), such as Microsoft's Windows™, is unnecessary and confusing. The operator's GUI should consist of labeled buttons and word lists with familiar terms.

The paperless factory machine operator's module should be able to replace all the paper that previously flowed to and from his or her workstation. It should automatically manage the communication functions by linking information from the correct sources and to the appropriate destinations. The operators should be managing their machines, while the system controls the information, giving them quick access to any documents necessary to attain the highest levels of productivity. It should also provide the means to collect data and report information to manufacturing systems that perform as SPC and labor tracking.

Graphic viewers provide MICS users with documents, drawings and digital photos at their workstations. Electronic folders may access any pertinent information on the network.

A well-designed interface presents the next job "folder" ready to be accessed. Clicking on this in turn presents a few choices, such as "Look at the work order, the gear program, a gear drawing, routing sheet, setup sheet or fixture drawing"; or "Check the ISO 9000 procedures or the SPC measurements."

When the operator is confident that everything is in order, she chooses the DNC button and downloads the file. As she works through the jobs, she reports her activity in the "job card" menu by indicating current activity. She can also access SPC input screens to enter measurements or collect data. The operator now functions as the "manager" of her portion of the work flow. She no longer wastes time in non-value-added activity, but concentrates on making good parts.

Programmers and process engineers who build the electronic folders and managers who monitor the production process also are part of the network and benefit from GUIs that fit their needs. Again, the ideal interface is one that provides all the necessary data quickly with a minimum of effort.

Manufacturing Information Control Systems

The MICS is the heart of this kind of system. As files build up from continual use of CAD, CAM and other applications, a means is needed to efficiently manage and control this data. A MICS is that means. When the operator clicks on a file in the folder, the MICS "knows" where it resides on the network and displays the document on the operator's screen. The operator immediately gets the information he needs, while the system keeps track of files, formats and revisions.

In order to manipulate files effectively, the MICS should be based on a system structure known as a relational database. This is the fastest and most effective software design for manipulating large amounts of data. Document files on the network can be viewed without being copied, which saves system user time and minimizes storage requirements. CIMNET™ Folders, from J.N.L. Industries of Robesonia, PA, is a leading MICS with a relational database designed specifically for manufacturers.

The computer functions that relate to the tasks that the operator performs—file viewing, CNC, job reporting, SPC and e-mail messaging—work most effectively when they are all part of a single, integrated system. The primary reasons for this are that the operator GUI is consistent for each function and that the data is part of the same relational database.

This improves the interaction among system users in several ways. For instance, if a change is made to a gear design, the change immediately shows up in the folder, and the operator gets the correct gear drawing and program

code. If there are questions from anyone on the system about a design or operation, messages can be immediately sent on the network, rather than through manually writing a message or walking somewhere to discuss the situation. DNC downloads and uploads can be initiated without switching to another system. Data can be collected about machine usage and operator time and immediately related to the job or operation. SPC instructions can be part of the folder, and as SPC measurements are collected, operators and quality control managers can monitor the accuracy of gears. Having SPC integrated into the same database allows for exceptional data analysis. For instance, if two machines are making the same gear, it is possible to compare each machine's and operator's performance and achieve the best production.

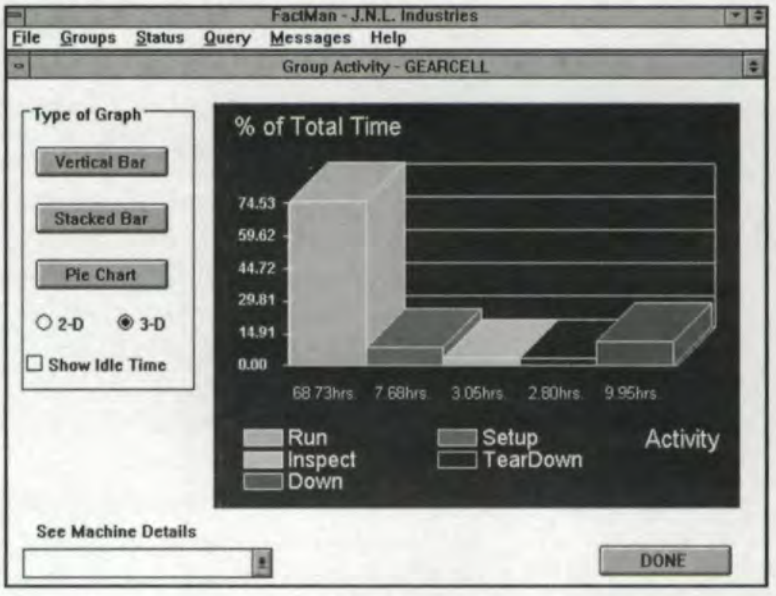
Open Systems

Very few manufacturing companies have not implemented some automation systems by now, so they have "legacy" hardware, software and archival data. These are valuable assets that cannot be allowed to become obsolete. It is not uncommon for a manufacturing company to have an existing Unix system, a mainframe and a PC network operating all in the same plant. A way is needed to maintain this data by getting control of these system files without throwing out the old systems. A good MICS, operating on industry standard computers and running within the popular networks and operating systems, will be able to work within this environment without requiring major changes.

The next detail to work out is to get everyone used to retrieving information on the network. First, the machine operators need to be trained on using the network system. A MICS, with its GUI and relational database, makes this a relatively easy task, but otherwise, it can be a fairly complex problem. The best way is to start with two or three types of files or documents and get everyone used to communicating over the network. The gear program, the work instructions and the drawings are good candidates.

Gear Manufacturing Implications

Some specific examples of how gear manufacturers can use a MICS involve the delivery of the necessary job information to the various operators. Each operation, such as roughing, hobbing, finish grinding, etc., will have an electronic folder where the operator retrieves instructions and reports progress. If SPC measurements are necessary, instructions are in the folder and data entry is accomplished by clicking on the SPC button. The system prompts for specific measurements, records data and makes sure the gears are staying within the required range. In the CIMNET™ Folders SPC module, the operator can collect data for measurement over wires, root diameter and O.D. In addition, measurements for runout, lead and involute can be taken and combined into a series of graphs to conduct comparison analysis of hobbing and grinding operations.



The FactMan module of Folders displays data collected and stored in the relational data base to indicate machine usage and analyze activity.

By being able to compare the same operation on various machines, a gear manufacturer can know immediately if an aerospace gear requiring a .002" tolerance can be manufactured on his current equipment and which machine would do the best job. Only a MICS with a relational database would be able to make this kind of comparison.

Conclusions

So is the "paperless" factory for you? Maybe not this year. Maybe not next. But somewhere, not too far down the road, the next move in the game to stay competitive will be to unify all your various electronic systems to get them to work together better. At that point, a MICS and the paperless factory will become a part of your manufacturing future. ✪

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