On-line computer programs NC 6 times faster than manual

THE ADVENT OF COMPUTER TECHNOLOGY has affected many areas of industry. Take, for example, the use of computers in the preparation and fine machining of small machine parts.

For Linamar Machine Ltd., a jobbing shop in Ariss, Ont. (near Guelph) NC machines have helped the company become a leader in its field and also contributed to its phenomenal growth.

Established in 1964 by owner and president Frank Hasenfratz, Linamar had its modest start in the form of one $300 lathe located in the basement of the owner's house.

Business was steady but really began to climb in 1968 when Hasenfratz bought the company's first NC Vertical Cintimatic with two-axis Acramatic 200 control. From these beginnings, the company has grown to the point where Linamar now grosses some $10 million a year.

"We have grown from a one-man operation to the point where we now employ some 140 people in a building currently occupying approximately 48,000 sq. ft. of floor space," says Hasenfratz.

"But we did things slowly. We went into computerized equipment very slowly, by first installing one NC machine and adding others as we grew."

Typical Linamar customers are manufacturers of military material, because 75 percent of the company's business is in the area of defence work. The remainder includes such diverse industries as automotive, aircraft and farm equipment, to name a few.

The company is considered to be heavily NC-oriented — it currently has 12 such machines, with a further three on order for delivery in 1977.

Explaining the company's confidence in the concept, Joe Lemmen, Linamar's programming supervisor, said, ". . . . with our new CNC machines (CNC replaces the hard-wired NC system with a computer and software to control the motions of the individual machine tool), we can actually change computer tapes right at the control." Another important benefit is that the control only reads the tape once and then runs the job from its memory banks. This in turn eliminates reading errors.
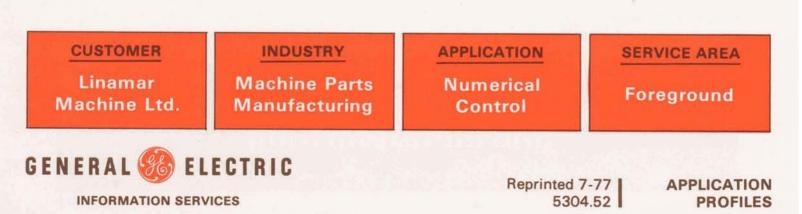
The only way to go

As far as Hasenfratz and Lemmen are concerned, NC machines are "the only way to go in this type of industry, particularly because close machining tolerances and minimization of human error are vital in the machining and finishing of small parts."

From an operational standpoint, Lemmen lists some of the advantages to be found in this form of equipment. First, he stressed the ease with which it maintains tolerances, stating that once the machine is set up with the appropriate computer tape it can virtually run itself. "For example," he said, "if we were turning a batch of parts with close tolerances on a manual engine lathe, more than likely we would end up with a grinding operation to achieve this close tolerance. If not, it would take a lot of care and time on the part of the machine operator as well as several set-ups."

In addition, there are ancillary, although equally-important benefits inherent in the NC system. One is that parts can be made more quickly, with a significant reduction in scrap material, while another is the consistency of sizes. There's considerably less margin for error and, for the operator, the mental fatigue resulting from having to keep extremely fine tolerances, manually, is eliminated.

From the bottom line point of view, meaningful cost savings may be derived from this form of mechanization, both Hasenfratz and Lemmen conclude.

But before you get to the operational cost savings, you must look first at the machine control. Paper tapes with the correct numerical coding must come from somewhere, and few small industries can afford to have their own computers. Some, like Linamar, have found that time-sharing solves many of their problems without incurring the expense of a complete in-house EDP system.

Manual programs expensive

When the company initially installed its NC machines, it used a manual tape preparation system. But it was found that, in Linamar's terms, "this system was not only inefficient, but costly." About a year ago, the company switched to time-sharing utilizing the services of Canadian General Electric's Mark III computer system.

The decision to go with the new system came as a result of the close examination by Hasenfratz of what his old system was actually costing the company.

"If we had not entered the CGE time-sharing network we would definitely have ended up with two more programmers in our systems department," he said. "First, we saved on manpower, which automatically saves on the physical space needed for those two men to work in. Then we saved on the cost of human error — because a computer, if it's programmed correctly, doesn't make as many mistakes.

"On our old system we created a new tape manually and put it on the machine. There's a lot of work in programming a tape manually and in certain of our jobs, profiling for example, it's very easy to make mistakes in calculating points. Once programmed, the tape was run through the machine tool and if it didn't work correctly, we had to come back, locate the error, change it and try again.

"In the meantime, our machine tool was sitting there and if it wasn't doing anything, it was not earning money."

By using time sharing, tape search and tape correction are at least six times faster than with the former method. "From a purely financial point of view, the ratio between productive hours and non-productive hours was so great that we simply had to do something," added Hasenfratz.

Fitting in with the owner's philosophy of doing things methodically, he and Lemmen conducted their own feasibility study before deciding which time-sharing firm they should use. Based on input from other CGE users, Hasenfratz placed his contract with that company for three basic reasons — "cost, service and reliability." CGE also offers an extraordinary lathe programming system called GETURN, plus other software for plotting, and so on.

Computer calculations

For an NC operation such as Linamar's, instructions to appear on the punched tape are prepared in either of two ways — one is by the manual programming method (previously mentioned); the second is by using a simplified programming language which the computer interprets and then makes all the necessary calculations automatically.

Lemmen noted the difference between the two, pointing out that with manual programming everything must be worked out, including the calculations of all points in a program. For example, whenever a tool part changes direction, that must be programmed, and each intricate step in machine movement must be programmed the same way.

"With our current system, all we need to do is define circles and lines and then tell the computer what form of tool or type of cutter we need. We might instruct that the program has to follow this line, from one line to another, past another, and so on, and the computer will then calculate all our points.

"The general information is exactly the same for every machine — the geometry, and so on, but the post processor will adapt this information to a specific machine tool."

He also said Linamar's own programmers start by preparing the job — what information to give the computer, and how various functions must be performed, such as tolerances, distances between points and so on.

The computer is then called via an ICP model NC/9 terminal and tape editing system, supplied by Bayer Business Machines of Toronto, and the information fed into it. The computer assimilates the information, processes it, relays the operating instructions onto a paper tape, and transmits the completed tape back to the sender.

Speaks various languages

As a Mark III user, a large number of programming languages are available to Linamar, including GETURN, the lathe programming system, plus APT and ADAPT, the universally accepted surface languages.

Call-up is quick and simple, utilizing ordinary telephone lines linked to the main computer. Then, instructions for the creation of a new tape are transmitted via a typewriter terminal attached to a tape receiver/duplicator. "We never have any problems with this system," said Lemmen, "because we just dial CGE's special telephone number and we get right into the machine."

Currently, Linamar has approximately 2,000 punched tapes in its possession, one for each different job order the company receives. "And this number is growing all the time," said Lemmen, "because new jobs are coming in constantly and they must all, of course, be programmed and have a tape prepared for them."

Now that Linamar has the operation of its NC machines established on Mark III, management is looking at other ways to utilize this time-sharing service.