



# Internetworking the factory floor proves strong value proposition

Using real-time data to assess, measure and improve performance.

By Thomas R. Cutler

Using the Internet to “internetwork” machine tools on the factory floor is proving to be a strong value proposition. This form of computerized networking for machine monitoring and control provide manufacturers with relevant production information in real-time, boosting efficiency by up to 20 per cent with minimal capital investment.

In the past, the key to maximizing productivity on the manufacturing shop floor was to automate machines, thereby minimizing costs and maintaining consistent quality. Process manufacturers have met the challenges of today’s extremely competitive environment by achieving a high degree of automation. Today, discrete manufacturers are asking: Can the advances of the process control world and the networked office be applied to automated machines on the shop floor? In other words, can the automation be automated? For certain discrete manufacturers, the answer is clearly “yes.” The productivity of these companies has been greatly enhanced when new technologies that shave off machining time, optimize labour efficiency, and extract high levels of quality are applied to existing automated machine tools.

**Imagine placing an order over the Internet to a manufacturer and having it filled and shipped all automatically without human intervention.**

John Rattray, a senior executive with Memex Automation suggests, “Modern machine tools remain largely closed ‘islands of automation’ whose isolation hinders the establishment of a fully connected, enterprise-wide information system. Unfortunately, largely because of the proprietary nature of the applications used by the 60 plus



machine tool manufacturers, the computerized numerical controls (CNCs) that run most modern machine tools do not communicate adequately with each other or with management information systems. Rather, these machines are primarily passive recipients of part program data. This lack of connectivity is a huge constraint on productivity — a problem recognized for many years by the machine tool industry.”

Almost two years ago, the Association of Manufacturing Technology (AMT) spent millions of dollars to establish a consortium, called MTConnect, whose mandate is to generate an Internet-based networking standard that will result in every machine tool becoming a node on the corporate network. The implementation of this standard connection will allow a manufacturer to identify and monitor every machine on the factory floor, and optimize total production throughput. The goal is to make every machine tool a vital part of management’s information system, and to integrate e-manufacturing into the enterprise-wide profit process.

Connecting machine tools on the shop floor to create an overall



plant “nervous system” unleashes the valuable information trapped in each machine. An ARC Survey Report suggests: “The largest reservoir of untapped operational information is locked in the machine tools on the manufacturing floor. Employing open architecture CNCs in a plant is fundamental in gaining a competitive advantage. Open architecture CNC integrated into the information technology mix is equally critical in optimizing production in both job shops and high production lines.” Once a company gains access to machine tool data, it can manage this information to increase profitability. The dynamic nature of internetworking extends the availability of production information far beyond the factory floor. Machine tools become active servers of information

in real-time, feeding their data to other functions within the corporation anywhere in the world. This increase in information dissemination leads to enhanced productivity and a sustainable competitive edge due to improvements in six key areas.

#### Increased machine utilization

Operations on any factory floor are linear (or sequential) in nature, with one event usually dependent on a preceding one and with considerable variation in time consumed. Machining, therefore, is currently a start-stop-wait-repeat process. Internetworking allows managers either to reduce or eliminate these wait periods or to exploit them by making key machine tools productive during these gaps. “Access to real-time data, including the monitoring of specific factors such as spindle load and cutting temperature, as well as DNC program loading, is necessary to accomplish this type of integrated systems

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optimization. Internetworking also eliminates or significantly reduces the 'wait-periods' now common in the manufacturing information process. Instead of having to wait for program delivery, tool offsets by hand, set-up, management approval, and the realization by front office accounting that inventory is ready to ship, the seamless integration of machines and management information systems turns 'just-in-time' processing into 'just-in-seconds' processing," Rattray adds.

### **Business systems integration**

Imagine placing an order over the Internet to a manufacturer and having it filled and shipped all automatically without human intervention. By establishing machine tool internetworking on the factory floor, the point of production can be connected directly to the supply chain on the one hand, and to the demand chain on the other. Ultimately, the factory floor can be linked to information systems already in place, such as enterprise resource planning software and standard accounting packages. The most common stumbling block to achieving such synchronous e-manufacturing integration between management planning, purchasing, production, operations, sales and service is establishing the direct link to the machine tool.

### **Establishment of OEE metrics**

Overall equipment effectiveness (OEE) is a percentage value that reflects a composite of machine availability, performance and quality. Companies aiming for a lean manufacturing process strive to implement OEE as a corporate-wide key performance indicator of company, division, plant and individual machine productivity. Currently, if OEE information is captured at all, it is typically written down on clipboards by hand and later transposed to a computer spreadsheet. The process is labour-intensive, subjective, prone to errors, and delays reporting of results. Real-time OEE determination allows for timely reporting and an immediate response if necessary. Rattray notes that, "Ideally, OEE information should be captured directly from a machine and conveyed electronically in real-time to both operators and management.

Internetworking allows the automatic capture and integration of OEE information from each machine, giving a complete digital picture of plant productivity at any given moment. This picture can then be viewed via the Internet by company personnel anywhere in the world."

### **Web enabling**

To date, very few manufacturers have adopted an e-manufacturing paradigm in which machine tools function as web-enabled appliances. However, all that is required to achieve web-enabling is to give every machine tool hardware and software upgrades that allow it to host Internet Protocol (IP) addresses. The machines can then be connected to each other and to the wider world, shattering the glass wall between the factory floor and the management functions that depend upon it.

### **Ease of service diagnostics**

Making a machine tool "smart" and a node in the corporate network introduces intuitiveness and transparency to the manufacturing process. Internetworking can allow the "neural network" on the shop floor to continuously optimize itself, bringing a new level of service to the entire corporation. Using a standard TCP/IP connection, remote monitoring of any machine can be done from anywhere in the corporation at any time, meaning that diagnostics and parts program recovery can be carried out from any location. Moreover, these services can be provided automatically, if and when the machine tool control itself sends out an alert to the corporate network. This concept of machine "self-healing," along with predictive and preventive maintenance, empower the operator to focus on more important details such as reducing bottlenecks and increasing availability.

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### **Continuous improvement**

The machine tool industry recognizes the need for internetworking machines on the factory floor and is moving to a set of standards that will permit integration with existing corporate information systems. At the September 2010 International Manufacturing Technology Show in Chicago, a consortium of major industry players including the top machine tool manufacturers continue to develop and advance a set of standard protocols for machine tool connectivity.



The goal of these protocols is to extend open architecture to all CNC machines and facilitate internetworking. Extending network connectivity to the factory floor brings the following benefits:

- Cost savings: inventory and operational expenses are reduced.
- Increased uptime: OEE information is provided to allow for continuous improvement. Preventive maintenance can be based on actual tool usage.
- Faster production: Machine operators and management can be alerted to adverse operational events and react to them very quickly. Increased bandwidth and speed

of internetworking decreases part program cycle time and aids production optimization.

- Improved service: Operational problems can be solved using remote diagnostics, decreasing downtime.

Humans originally built machines to make manufacturing easier. The time has come to let machines do what they do best — repetitive, high-volume and even dangerous tasks. This frees humans to do what we do best — create, design, build and dream. An internetworked factory floor is an advance that will enhance a manufacturer's bottom line and give the company a sustainable competitive edge through business productivity. ■

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