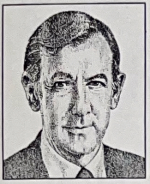
APPLIED INTELLIGENCE

Trends in Technology Will Affect Business Strategies



JAMES MARTIN

This is the second of a three-part series on new computer technologies that are destined to have great strategic importance in the future.

Computer technology continues with its rapid advances, giving organizations significant opportunities to gain competitive advantage. Many strategically oriented corporations have used improvements in hardware and software technology to restructure their businesses, introduce new products, enter new businesses and improve development productivity.

Important trends in computer hardware technology include the rapid movement toward a distributed workstation environment, major increases in the processing speed of microprocessors, ultraparallel processing, specialized inference processors, neurocomputers, optical-fiber communication, optical disks, all-digital, high-speed telecommunications and advanced microchip technology. It's important to gauge where this technology is going and what effect it will have on the future competitive business environment.

For example, changes are occurring very rapidly in microprocessor technology. The cost of chips in PCs has become much lower than the cost of chips in mainframe computers. This difference can be translated into the cost of doing a job.

The cost of mips (million instructions per second) on a large mainframe today is about two orders of magnitude greater than the cost of mips on a desktop 80386-based PC. There are several reasons why this is true. One is that the lead time to build a PC is about a year, while the lead time to build a mainframe is about six years. We can get new technology into the PC much faster than it can be implemented in a mainframe.

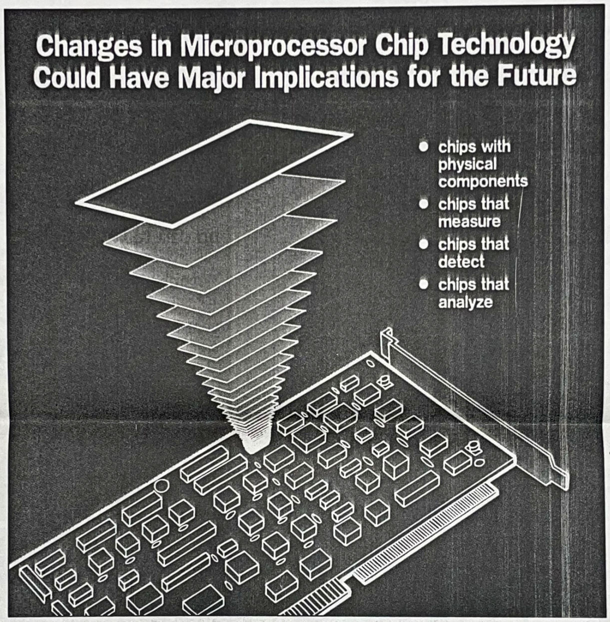
The second reason is that there isn't much competition in the mainframe area. A lot of information-systems executives worry about the fact that there is inadequate competition in top-of-the-line mainframes, while in the area of PCs there is absolutely intense competition, which significantly drives down the cost of mips.

The third reason is perhaps more fundamental: The mainframe is built out of bipolar technology, and the PC is built using FET (field-effect transistor) or CMOS (complementary metal-oxide semiconductor) technology. With bipolar technology, heat is generated all the time. With CMOS technology, however, heat is generated only when the component is switched or when information is read from memory.

In the mainframe, we need high processing speed, which requires bipolar technology and results in the dissipation of a great deal of heat. This leads to a requirement for a large number of low-density chips and off-chip wiring—all of which make the mainframe processor very expensive.

The personal computer does not require very high speeds; therefore, CMOS chips that don't need expensive cooling can be used. As a result, PCs have high chip density, relatively few chips and little off-chip wiring.

Another new technology that has major implications for the future is neurocomputer technology. A neurocomputer contains large numbers of electronic models of neurons with a high degree of connectivity between them. Neurocomputers are now available on boards that can be plugged into conventional personal computers. These boards enable a PC to accomplish such tasks as the recognition of the characteristics of a specific face, which we cannot do at the present time with the world's fastest supercomputers.



Maryellen Zawatski

It's important to gauge where advances in hardware and software technology are going, and what effect they will have on the business strategies of companies in the future.

Although there are many potentially valuable applications of neurocomputers in business, most business and information-systems professionals don't seem to know much about them. Some of the applications are likely to be of major strategic importance in business.

Today's neurocomputers, although they can do things that the Cray 2 can't do in isolated applications, are nevertheless very crude compared with what we can build in the future. An important question is, How many neurons can we put on a chip or on a large-scale wafer?

One of the problems with wafer-scale integration is that there is typically a lot of damage to individual components, rendering portions of the wafer inoperable. Perfect wafers cannot be made with current manufacturing technology. However, with neurocomputers, if some of the electronic neurons are dead, there is little effect on the overall operation of the wafer. Thus, there's a natural match between the operation of neurocomputers and the manufacturing techniques of wafer-scale integration.

Similar arguments apply to making optical neurocomputers. Bell Labs is working intensively on the development of optical neurocomputers. We can predict how many neurons can be put on a wafer in the years 1990, 2000 and 2010. We can be fairly sure that, by about 2010, we can build a neurocomputer with as many neurons as the human brain. However, the electronic neurocomputer will operate 10 million times faster than the human brain!

What applications can such an electronic device perform? It won't be able to do the same things a human brain can do because we have such a poor understanding of what goes on in the human brain. It's likely the neurocomputer will appear simplistic compared with the human brain, but it will perform simplistic functions extremely fast.

There are very important applications of neurocomputing in telecommunications and in defense. Neurocomputers will enable us to build intelligent telecommunication networks and smart weapon systems that can recognize their target from a long distance away and home in on it. The Department of Defense recently announced a $30 million program to build a neurosupercomputer.

There is another fascinating type of chip coming into existence. It's a chip that has physical components, not just logical components, and implements many different types of microsensors. For example, there's one chip which contains tiny whiskers, similar to tuning forks, that can detect low-level vibrations. Other chips measure the flow of gases or air. Another type of chip developed by IBM can detect exceedingly subtle motions. IBM built a ballpoint pen with this chip in the tip of the pen. The pen is able to analyze the subtle motions associated with writing and can be used to detect forgeries.

Over the last 15 years, we've seen the marriage of the computer and telecommunications. In 1965, the telecommunications industry was completely separate from the computer industry, and nobody thought that they would ever have anything to do with each other. By 1995 there's going to be a large amount of overlap between the companies that make things for telecommunicating and the companies that make products for computing.

In a similar way, the television industry is completely separate from the newspaper and magazine industry, and both are completely separate from the computer business. However, if we look at those industries in about 2005, we will find a high level of overlap between the television and broadcasting business, and between the newspaper/magazine business and the computer business.

Those industries are converging as we enter the age of hypertext and hyper media, intelligent television and intelligent books. Every television will become a computer and every computer a television set. Again we need to ask, what are the implications of the merger of technologies? Who is taking advantage of it? Who is completely unaware that that is happening?

Most importantly, if we put these different sets of facts about technology together, what machines can be built with those electronic components, what applications will become possible, and what is the strategic importance of these applications?

Next week, I will look at the effects of improvements in technology on society. ∎

The James Martin Productivity Series, an information-service updated quarterly, is available through High Productivity Software Inc., of Marblehead, Mass. (800) 242-1240. For information on seminars, contact (in the United States and Canada) Technology Transfer Institute, 741 10th St., Santa Monica, Calif. 90402 (213) 394-8305. In Europe, contact Savant, 2 New St., Carnforth, Lancs., LA5 9BX United Kingdom (0524) 734 505.